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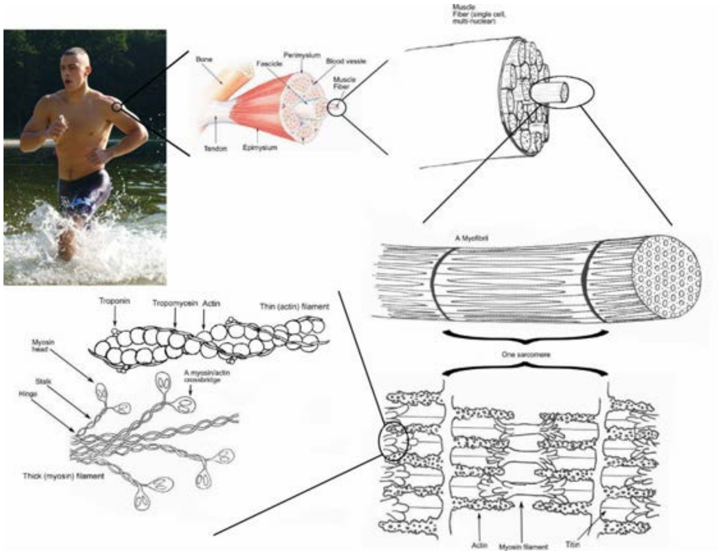
Chapter 1

Muscle



Muscle (from Latin *musculus*, diminutive of *mus* "mouse") is a Muscle contraction tissue (biology) of animals and is derived from the Germ layer of embryonic germ cells. Myocyte contain contractile filaments that move past each other and change the size of the cell. They are classified as skeletal muscle, cardiac muscle, or smooth muscle muscles. Their function is to produce force and cause motion (physics). Muscles can cause either locomotion of the organism itself or movement of organ (anatomy). Cardiac and smooth muscle contraction occurs without consciousness thought and is necessary for survival. Examples are the contraction of the heart and peristalsis which pushes food through the digestion. Voluntary contraction of the skeletal muscles is used to move the body and can be finely controlled. Examples are movements of the eye, or gross movements like the quadriceps femoris muscle of the thigh. There are two broad types of voluntary muscle fibers: slow twitch and fast twitch. Slow twitch fibers contract for long periods of time but with little force while fast twitch fibers contract quickly and powerfully but fatigue very rapidly.

Muscles are predominately powered by the Redox of fats and carbohydrates, but Anaerobic respiration chemical reactions are also used, particularly by fast twitch fibers. These chemical reactions produce adenosine triphosphate (ATP) molecules which are used to power the movement of the myosin heads.

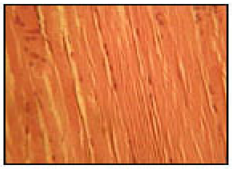
1.1 Embryology

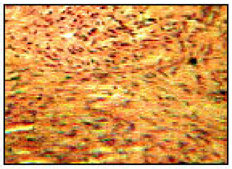
All muscles derive from paraxial mesoderm. The paraxial mesoderm is divided along the embryo's length into somites, corresponding to the Segmentation (biology) of the body (most obviously seen in the vertebral column. Each somite has 3 divisions, sclerotome (which forms vertebrae), Dermatome (anatomy) (which forms skin), and myotome (which forms muscle). The myotome is divided into two sections, the epimere and hypomere, which form epaxial and hypaxial muscles and epaxial and hypaxial muscles muscles, respectively. Epaxial muscles in humans are only the erector spinae muscles and small intervertebral muscles, and are innervated by the dorsal rami of the spinal nerves. All other muscles, including limb muscles, are hypaxial muscles, formed from the hypomere, and inervated by the ventral rami of the spinal nerves.

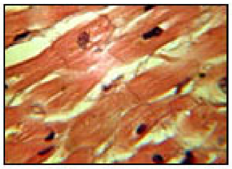
During development, myoblasts (muscle progenitor cells) either remain in the somite to form muscles associated with the vertebral column or migrate out into the body to form all other muscles. Myoblast migration is preceded by the formation of connective tissue frameworks, usually formed from the somatic lateral plate mesoderm. Myoblasts follow chemical signals to the appropriate locations, where they fuse into elongate skeletal muscle cells.

1.2 Types

There are three types of muscle:


Skeletal muscle


Smooth muscle


Cardiac muscle

- Skeletal muscle or "voluntary muscle" is anchored by tendons (or by aponeurosis at a few places) to bone and is used to effect skeleton movement such as animal locomotion and in maintaining posture. Though this postural control is generally maintained as a subconscious reflex, the muscles responsible react to conscious control like non-postural muscles. An average adult male is made up of 42% of skeletal muscle and an average adult female is made up of 36% (as a percentage of body mass).
- Smooth muscle or "involuntary muscle" is found within the walls of organs and structures such as the esophagus, stomach, intestines, bronchus, uterus, urethra, Urinary bladder, blood vessels, and the erectores pilorum in the skin (in which it controls erection of body hair). Unlike skeletal muscle, smooth muscle is not under conscious control.
- Cardiac muscle is also an "involuntary muscle" but is more akin in structure to skeletal muscle, and is found only in the heart.

Cardiac and skeletal muscles are "striated" in that they contain sarcomeres and are packed into highly regular arrangements of bundles; smooth muscle has neither. While skeletal muscles are arranged in regular, parallel bundles, cardiac muscle connects at branching, irregular angles (called intercalated discs). Striated muscle contracts and relaxes in short, intense bursts, whereas smooth muscle sustains longer or even near-permanent contractions.

Skeletal muscle is further divided into several subtypes:

- Type I, slow oxidative, slow twitch, or "red" muscle is dense with capillary and is rich in mitochondria and myoglobin, giving the muscle tissue its characteristic red color. It can carry more oxygen and sustain aerobic metabolism activity.
- Type II, fast twitch muscle, has three major kinds that are, in order of increasing contractile speed:

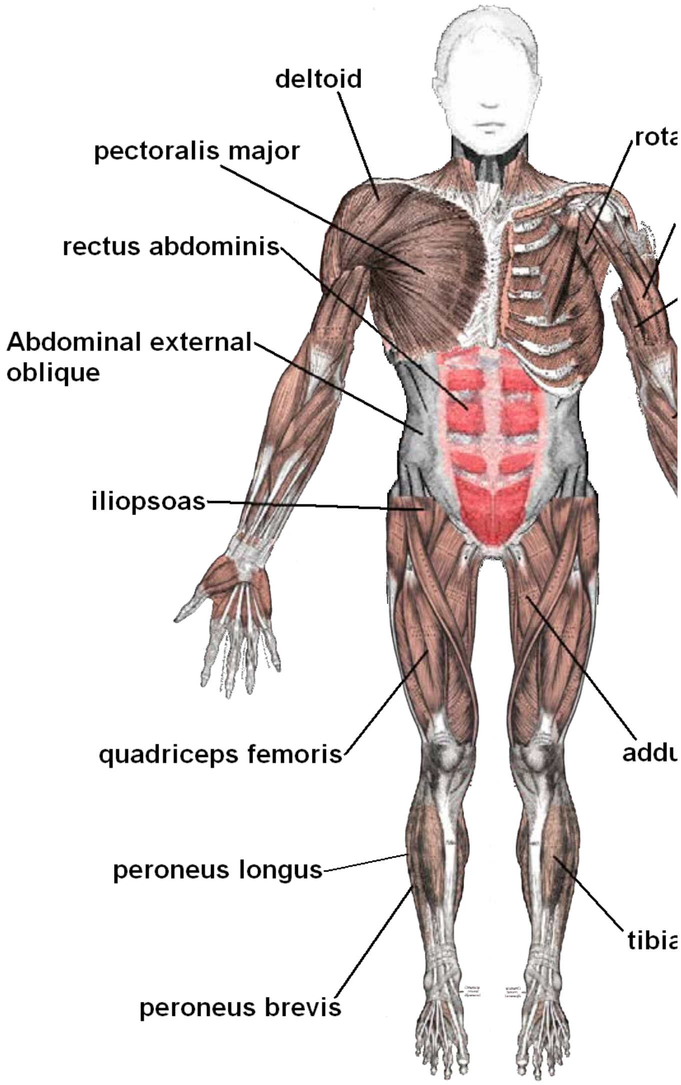
  - Type IIa, which, like slow muscle, is aerobic, rich in mitochondria and capillaries and appears red.
  - Type IIx (also known as type IId), which is less dense in mitochondria and myoglobin. This is the fastest muscle type in humans. It can contract more quickly and with a greater amount of force than oxidative muscle, but can sustain only short, Fermentation (biochemistry) bursts of activity before muscle contraction becomes painful (often incorrectly attributed to a build-up of lactic acid). N.B. in some books and articles this muscle in humans was, confusingly, called type IIB.
  - Type IIb, which is anaerobic, glycolysis, ”white” muscle that is even less dense in mitochondria and myoglobin. In small animals like rodents this is the major fast muscle type, explaining the pale color of their flesh.

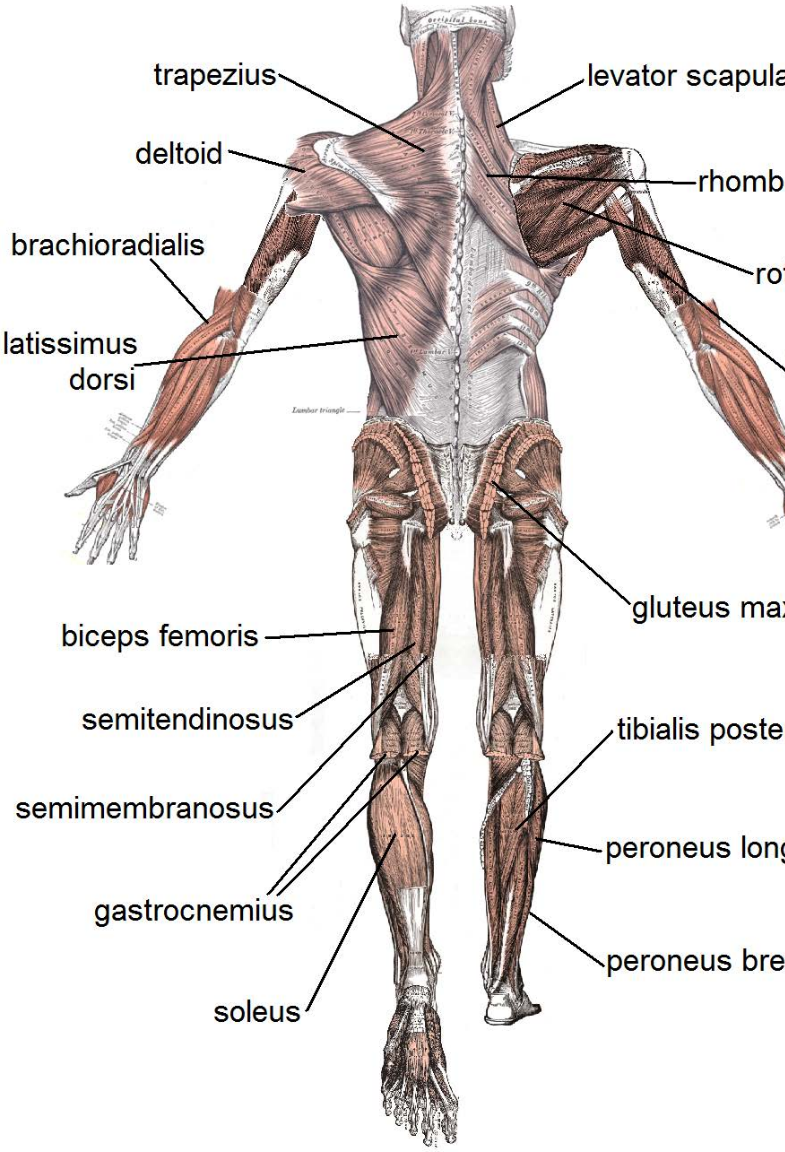
1.3 Anatomy

The anatomy of muscles includes both gross anatomy, comprising all the muscles of an organism, and, on the other hand, microanatomy, which comprises the structures of a single muscle.

Gross anatomy

Table 1.1:





The gross anatomy of a muscle is the most important indicator of its role in the body. The action a muscle generates is determined by the origin and insertion locations. The cross-sectional area of a muscle (rather than volume or length) determines the amount of force it can generate by defining the number of sarcomeres which can operate in parallel. The amount of force applied to the external environment is determined by lever mechanics, specifically the ratio of in-lever to out-lever. For example, moving the insertion point of the biceps more distally on the radius (farther from the joint of rotation) would increase the force generated during flexion (and, as a result, the maximum weight lifted in this movement), but decrease the maximum speed of flexion. Moving the insertion point proximally (closer to the joint of rotation) would result in decreased force but increased velocity. This can be most easily seen by comparing the limb of a mole to a horse - in the former, the insertion point is positioned to maximize force (for digging), while in the latter, the insertion point is positioned to maximize speed (for running).

One particularly important aspect of gross anatomy of muscles is Pennate muscle or lack thereof. In most muscles, all the fibers are oriented in the same direction, running in a line from the origin to the insertion.

In pennate muscles, the individual fibers are oriented at an angle relative to the line of action, attaching to the origin and insertion tendons at each end. Because the contracting fibers are pulling at an angle to the overall action of the muscle, the change in length is smaller, but this same orientation allows for more fibers (thus more force) in a muscle of a given size. Pennate muscles are usually found where their length change is less important than maximum force, such as the rectus femoris.

There are approximately 639 skeletal muscles in the human body . However, the exact number is difficult to define because different sources group muscles differently and some muscles, such as palmaris longus, are variably present in humans.

Main article: Table of muscles of the human body

Microanatomy

Muscle is mainly composed of muscle cell (biology). Within the cells are myofibrils; myofibrils contain sarcomeres, which are composed of actin and myosin. Individual muscle fibres are surrounded by endomysium. Muscle fibers are bound together by perimysium into bundles called Muscle fascicle; the bundles are then grouped together to form muscle, which is enclosed in a sheath of epimysium. Muscle spindles are distributed throughout the muscles and provide sensory feedback information to the central nervous system.

Skeletal muscle is arranged in discrete muscles, an example of which is the *biceps brachii muscle*. It is connected by tendons to processes of the skeleton. Cardiac muscle is similar to skeletal muscle in both composition and action, being made up of myofibrils of sarcomeres, but anatomically different in that the muscle fibers are typically branched like a tree and connect to other cardiac muscle fibers through intercalcated discs, and form the appearance of a syncytium.

1.4 Physiology

Main article: muscle contractionThe three types of muscle (skeletal, cardiac and smooth) have significant differences. However, all three use the movement of actin against myosin to create Muscle contraction. In skeletal muscle, contraction is stimulated by action potential transmitted by the nerves, the motoneurons (motor nerves) in particular. Cardiac and smooth muscle contractions are stimulated by internal pacemaker cells which regularly contract, and propagate contractions to other muscle cells they are in contact with. All skeletal muscle and many smooth muscle contractions are facilitated by the neurotransmitter acetylcholine.

Muscular activity accounts for much of the body's energy consumption. All muscle cells produce adenosine triphosphate (ATP) molecules which are used to power the movement of the myosin heads. Muscles conserve energy in the form of creatine phosphate which is generated from ATP and can regenerate ATP when needed with creatine kinase. Muscles also keep a storage form of glucose in the form of glycogen. Glycogen can be rapidly converted to glucose when energy is required for sustained, powerful contractions. Within the voluntary skeletal muscles, the glucose molecule can be metabolized anaerobically in a process called glycolysis which produces two ATP and two lactic acid molecules in the process (note that in aerobic conditions, lactate is not formed; instead pyruvate is formed and transmitted through the citric acid cycle). Muscle cells also contain globules of fat, which are used for energy during aerobic exercise. The aerobic energy systems take longer to produce the ATP and reach peak efficiency, and requires many more biochemical steps, but produces significantly more ATP than anaerobic glycolysis. Cardiac muscle on the other hand, can readily consume any of the three macronutrients (protein, glucose and fat) aerobically without a 'warm up' period and always extracts the maximum ATP yield from any molecule involved. The heart, liver and red blood cells will also consume lactic acid produced and excreted by skeletal muscles during exercise.

1.5 Nervous control

Efferent leg

The Efferent nerve fiber leg of the peripheral nervous system is responsible for conveying commands to the muscles and glands, and is ultimately responsible for voluntary movement. Nerves move muscles in response to somatic nervous system and autonomic nervous system (involuntary) signals from the brain. Deep muscles, superficial muscles, Muscles of head and internal muscles all correspond with dedicated regions in the primary motor cortex of the human brain, directly anterior to the central sulcus that divides the frontal and parietal lobes.

In addition, muscles react to reflex action nerve stimuli that do not always send signals all the way to the brain. In this case, the signal from the afferent fiber does not reach the brain, but produces the reflexive movement by direct connections with the efferent nerves in the Spinal cord. However, the majority of muscle activity is volitional, and the result of complex interactions between various areas of the brain.

Nerves that control skeletal muscles in mammals correspond with neuron groups along the primary motor cortex of the brain's cerebral cortex. Commands are routed though the basal ganglia and are modified by input from the cerebellum before being relayed through the pyramidal tract to the spinal cord and from there to the motor end plate at the muscles. Along the way, feedback, such as that of the extrapyramidal system contribute signals to influence muscle tone and response.

Deeper muscles such as those involved in Human position often are controlled from nuclei in the brain stem and basal ganglia.

Afferent leg

The Afferent nerve fiber leg of the peripheral nervous system is responsible for conveying sensory information to the brain, primarily from the sense organs like the skin. In the muscles, the muscle spindles convey information about the degree of muscle length and stretch to the central nervous system to assist in maintaining posture and joint position. The sense of where our bodies are in space is called proprioception, the perception of body awareness. More easily demonstrated than explained, proprioception is the ”unconscious” awareness of where the various regions of the body are located at any one time. This can be demonstrated by anyone closing their eyes and waving their hand around. Assuming proper proprioceptive function, at no time will the person lose awareness of where the hand actually is, even though it is not being detected by any of the other senses.

Several areas in the brain coordinate movement and position with the feedback information gained from proprioception. The cerebellum and red nucleus in particular continuously sample position against movement and make minor corrections to assure smooth motion.

1.6 Exercise

Main article: Physical exercise Exercise is often recommended as a means of improving motor skills, physical fitness, muscle and bone strength, and joint function. Exercise has several effects upon muscles, connective tissue, bone, and the nerves that stimulate the muscles. One such effect is muscle hypertrophy, an increase in size. This is used in bodybuilding.

Various exercises require a predominance of certain muscle fiber utilization over another. Aerobic exercise involves long, low levels of exertion in which the muscles are used at well below their maximal contraction strength for long periods of time (the most classic example being the marathon). Aerobic events, which rely primarily on the aerobic (with oxygen) system, use a higher percentage of Type I (or slow-twitch) muscle fibers, consume a mixture of fat, protein and carbohydrates for energy, consume large amounts of oxygen and produce little lactic acid. Anaerobic exercise involves short bursts of higher intensity contractions at a much greater percentage of their maximum contraction strength. Examples of anaerobic exercise include sprinting and weight training. The anaerobic energy delivery system uses predominantly Type II or fast-twitch muscle fibers, relies mainly on ATP or glucose for fuel, consumes relatively little oxygen, protein and fat, produces large amounts of lactic acid and can not be sustained for as long a period as aerobic exercise. The presence of lactic acid has an inhibitory effect on ATP generation within the muscle; though not producing fatigue, it can inhibit or even stop performance if the intracellular concentration becomes too high. However, long-term training causes neovascularization within the muscle, increasing the ability to move waste products out of the muscles and maintain contraction. Once moved out of muscles with high concentrations within the sarcomere, lactic acid can be used by other muscles or body tissues as a source of energy, or transported to the liver where it is converted back to pyruvate. In addition to increasing the level of lactic acid, strenuous exercise causes the loss of potassium ions in muscle and causing an increase in potassium ion concentrations close to the muscle fibres, in the interstitium. Acidification by lactic acid may allow recovery of force so that acidosis may protect against fatigue rather than being a cause of fatigue.

Humans are genetically predisposed with a larger percentage of one type of muscle group over another. An individual born with a greater percentage of Type I muscle fibers would theoretically be more suited to endurance events, such as triathlons, distance running, and long cycling events, whereas a human born with a greater percentage of Type II muscle fibers would be more likely to excel at anaerobic events such as a 200 meter dash, or weightlifting.

Delayed onset muscle soreness is pain or discomfort that may be felt one to three days after exercising and subsides generally within two to three days later. Once thought to be caused by lactic acid buildup, a more recent theory is that it is caused by tiny tears in the muscle fibers caused by Muscle contraction#Eccentric contraction, or unaccustomed training levels. Since lactic acid disperses fairly rapidly, it could not explain pain experienced days after exercise.

Muscular, spinal and neural factors all affect muscle building. Sometimes a person may notice an increase in strength in a given muscle even though only its opposite has been subject to exercise, such as when a bodybuilder finds her left biceps stronger after completing a regimen focusing only on the right biceps. This phenomenon is called cross education.

1.7 Disease

Main article: Neuromuscular diseaseSymptoms of muscle diseases may include Muscle weakness, spasticity, myoclonus and myalgia. Diagnostic procedures that may reveal muscular disorders include testing creatine kinase levels in the blood and electromyography (measuring electrical activity in muscles). In some cases, muscle biopsy may be done to identify a myopathy, as well as genetic testing to identify DNA abnormalities associated with specific myopathies and Muscular dystrophy.

Neuromuscular diseases are those that affect the muscles and/or their nervous control. In general, problems with nervous control can cause spasticity or paralysis, depending on the location and nature of the problem. A large proportion of neurological disorders leads to problems with movement, ranging from cerebrovascular accident (stroke) and Parkinson's disease to Creutzfeldt-Jakob disease.

A non-invasive elastography technique that measures muscle noise is undergoing experimentation to provide a way of monitoring neuromuscular disease. The sound produced by a muscle comes from the shortening of actomyosin Protein filament along the axis of the muscle. During Muscle contraction, the muscle shortens along its longitudinal axis and expands across the Transverse plane, producing vibrations at the surface.

Atrophy

Main article: Muscle atrophyThere are many diseases and conditions which cause a decrease in muscle mass, known as muscle atrophy. Examples include cancer and AIDS, which induce a body wasting syndrome called cachexia. Other syndromes or conditions which can induce skeletal muscle atrophy are Heart failure and some Hepato-biliary diseases.

During aging, there is a gradual decrease in the ability to maintain skeletal muscle function and mass, known as sarcopenia. The exact cause of sarcopenia is unknown, but it may be due to a combination of the gradual failure in the ”satellite cells” which help to regenerate skeletal muscle fibers, and a decrease in sensitivity to or the availability of critical secreted growth factors which are necessary to maintain muscle mass and satellite cell survival. Sarcopenia is a normal aspect of aging, and is not actually a disease state yet can be linked to many injuries in the elderly population as well as decreasing quality of life.

Atrophy is of particular interest to the manned spaceflight community, since the weightlessness experienced in spaceflight results is a loss of as much as 30% of mass in some muscles.

Physical inactivity and atrophy

Inactivity and starvation in mammals lead to atrophy of skeletal muscle, accompanied by a smaller number and size of the muscle cells as well as lower protein content. In humans, prolonged periods of immobilization, as in the cases of bed rest or astronauts flying in space, are known to result in muscle weakening and atrophy. Such consequences are also noted in small hibernating mammals like the golden-mantled ground squirrels and brown bats.

Bears are an exception to this rule; species in the family Ursidae are famous for their ability to survive unfavorable environmental conditions of low temperatures and limited nutrition availability during winter by means of hibernation. During that time, bears go through a series of physiological, morphological and behavioral changes. Their ability to maintain skeletal muscle number and size at time of disuse is of a significant importance.

During hibernation, bears spend four to seven months of inactivity and anorexia without undergoing muscle atrophy and protein loss. There are a few known factors that contribute to the sustaining of muscle tissue. During the summer period, bears take advantage of the nutrition availability and accumulate muscle protein. The protein balance at time of dormancy is also maintained by lower levels of protein breakdown during the winter time. At times of immobility, muscle wasting in bears is also suppressed by a proteolytic inhibitor that is released in circulation. Another factor that contributes to the sustaining of muscle strength in hibernating bears is the occurrence of periodic voluntary contractions and involuntary contractions from shivering during torpor. The three to four daily episodes of muscle activity are responsible for the maintenance of muscle strength and responsiveness in bears during hibernation.

1.8 Strength

A display of ”strength” (e.g. lifting a weight) is a result of three factors that overlap: **physiological strength** (muscle size, cross sectional area, available crossbridging, responses to training), **neurological strength** (how strong or weak is the signal that tells the muscle to contract), and **mechanical strength** (muscle’s force angle on the lever, moment arm length, joint capabilities). Contrary to popular belief, the number of muscle fibres cannot be increased through Physical exercise; instead the muscle cells simply get bigger. Muscle fibres have a limited capacity for growth through Organ hypertrophy and some believe they split through hyperplasia if subject to increased demand.

Physiological strength

Vertebrate muscle typically produces approximately 25”0303http://en.wikipedia.org/w/index.php?title=Newton_-%28unit%29Newton (unit) (5.6”0303http://en.wikipedia.org/w/index.php?title=pound-forcepound-force) of force per square centimeter of muscle cross-sectional area when isometric and at optimal length. Some invertebrate muscles, such as in crab claws, have much longer sarcomeres than vertebrates, resulting in many more sites for actin and myosin to bind and thus much greater force per square centimeter.

The strength of any given muscle, in terms of force exerted on the skeleton, depends upon Muscle contraction#Force-length and force-velocity relationships, cross sectional area, Pennate muscle, sarcomere length, and myosin isoform.

The ”strongest” human muscle

Since three factors affect muscular strength simultaneously and muscles never work individually, it is misleading to compare strength in individual muscles, and state that one is the ”strongest”. But below are several muscles whose strength is noteworthy for different reasons.

- In ordinary parlance, muscular ”strength” usually refers to the ability to exert a force on an external object—for example, lifting a weight. By this definition, the masseter or jaw muscle is the strongest. The 1992 Guinness Book of Records records the achievement of a bite strength of 4337”0303http://en.wikipedia.org/w/index.php?title=Newton_%28unit%29Newton (unit) (975”0303http://en.w forcepound-force) for 2 seconds. What distinguishes the masseter is not anything special about the muscle itself, but its advantage in working against a much shorter lever arm than other muscles.
- If ”strength” refers to the force exerted by the muscle itself, e.g., on the place where it inserts into a bone, then the strongest muscles are those with the largest cross-sectional area. This is because the tension exerted by an individual skeletal muscle fiber does not vary much. Each fiber can exert a force on the order of 0.3 micronewton. By this definition, the strongest muscle of the body is usually said to be the Quadriceps or the gluteus maximus.
- A shorter muscle will be stronger ”pound for pound” (i.e., by mass) than a longer muscle. The myometrial layer of the uterus may be the strongest muscle by weight in the female human body. At the time when an infant is delivered, the entire human uterus weighs about 1.1k̃g (40õz). During childbirth, the uterus exerts 100 to 400 N (25 to 100l̃bf) of downward force with each contraction.
- The external muscles of the eye are conspicuously large and strong in relation to the small size and weight of the human eyeball. It is frequently said that they are ”the strongest muscles for the job they have to do” and are sometimes claimed to be ”100 times stronger than they need to be.” However, eye movements (particularly saccades used on facial scanning and reading) do require high speed movements, and eye muscles are exercised nightly during rapid eye movement sleep.
- The statement that ”the tongue is the strongest muscle in the body” appears frequently in lists of surprising facts, but it is difficult to find any definition of ”strength” that would make this statement true. Note that the tongue consists of eight muscles, not one.
- The heart has a claim to being the muscle that performs the largest quantity of physical work in the course of a lifetime. Estimates of the power output of the human heart range from 1 to 5 watts. This is much less than the maximum power output of other muscles; for example, the Quadriceps femoris muscle can produce over 100 watts, but only for a few minutes. The heart does its work continuously over an entire lifetime without pause, and thus does ”outwork” other muscles. An output of one watt continuously for eighty years yields a total work output of two and a half gigajoules.

1.9 Efficiency

The mechanical efficiency of human muscle has been measured (in the context of Watercraft rowing and cycling) at 18% to 26%. The efficiency is defined as the ratio of mechanical work output to the total metabolism cost, as can be calculated from oxygen consumption. This low efficiency is the result of about 40% efficiency of generating Adenosine triphosphate from food energy, losses in converting energy from ATP into mechanical work inside the muscle, and mechanical losses inside the body. The latter two losses are dependent on the type of exercise and the type of muscle fibers being used (fast-twitch or slow-twitch). For an overal efficiency of 20 percent, one watt of mechanical power is equivalent to 4.3 kcal per hour. For example, a manufacturer of rowing equipment shows burned calories as four times the actual mechanical work, plus 300 kcal per hour, which amounts to about 20 percent efficiency at 250 watts of mechanical output. The mechanical energy output of a cyclic contraction can depend upon many factors, including activation timing, muscle strain trajectory, and rates of force rise & decay. These can be synthesized experimentally using Work Loop.

1.10 Density of muscle tissue compared to adipose tissue

The density of mammalian skeletal muscle tissue is about 1.06k̆g/liter. This can be contrasted with the density of adipose tissue (fat), which is 0.9196k̆g/liter. This makes muscle tissue approximately 15% denser than fat tissue.

1.11 Resting energy expenditure of muscle

At rest, skeletal muscle consumes 54.4 kJ/kg(̆13.0k̆cal/kg) per day. This is larger than adipose tissue (fat) at 18.8k̆J/kg (4.5k̆cal/kg), and bone at 9.6k̆J/kg (2.3k̆cal/kg).

1.12 Muscle evolution

Evolutionarily, specialized forms of skeletal and cardiac muscles predated the divergence of the vertebrate/arthropod evolutionary line. This indicates that these types of muscle developed in a common ancestor sometime before 700 mya (unit). Vertebrate smooth muscle was found to have evolved independently from the skeletal and cardiac muscles.

1.13 See also

- Atrophy
- Bodybuilding
- Cross education
- Electroactive polymers (materials that behave like muscles, used in robotics research)
- Fascia
- Hand strength
- In vitro muscle testing
- List of muscles of the human body
- List of weight training exercises

- Muscle atrophy
- Muscle memory
- Muscle tone (residual muscle tension)
- Musculoskeletal system
- Muscular system
- Myopathy (pathology of muscle cells)
- Myotomy
- Phonomyography
- Preflexes
- Rapid plant movement
- Rohmert's law
- Soft tissue

1.14 External links

- Muslumova, Irada (2003). "Power of a Human Heart". *The Physics Factbook*. `http://hypertextbook.com/facts/2003/IradaMuslumova.shtml`. (Heart output 1.3 to 5 watts, lifetime output 2 to 3 $\times 10^9$ joules)
- University of Dundee article on performing neurological examinations (Quadriceps "strongest")
- Muscle efficiency in rowing
- Human Muscle Tutorial (clear pictures of main human muscles and their Latin names, good for orientation)
- Microscopic stains of skeletal and cardiac muscular fibers to show striations. Note the differences in myofibrilar arrangements.

mhr: pnb:

Chapter 2

List of muscles of the human body

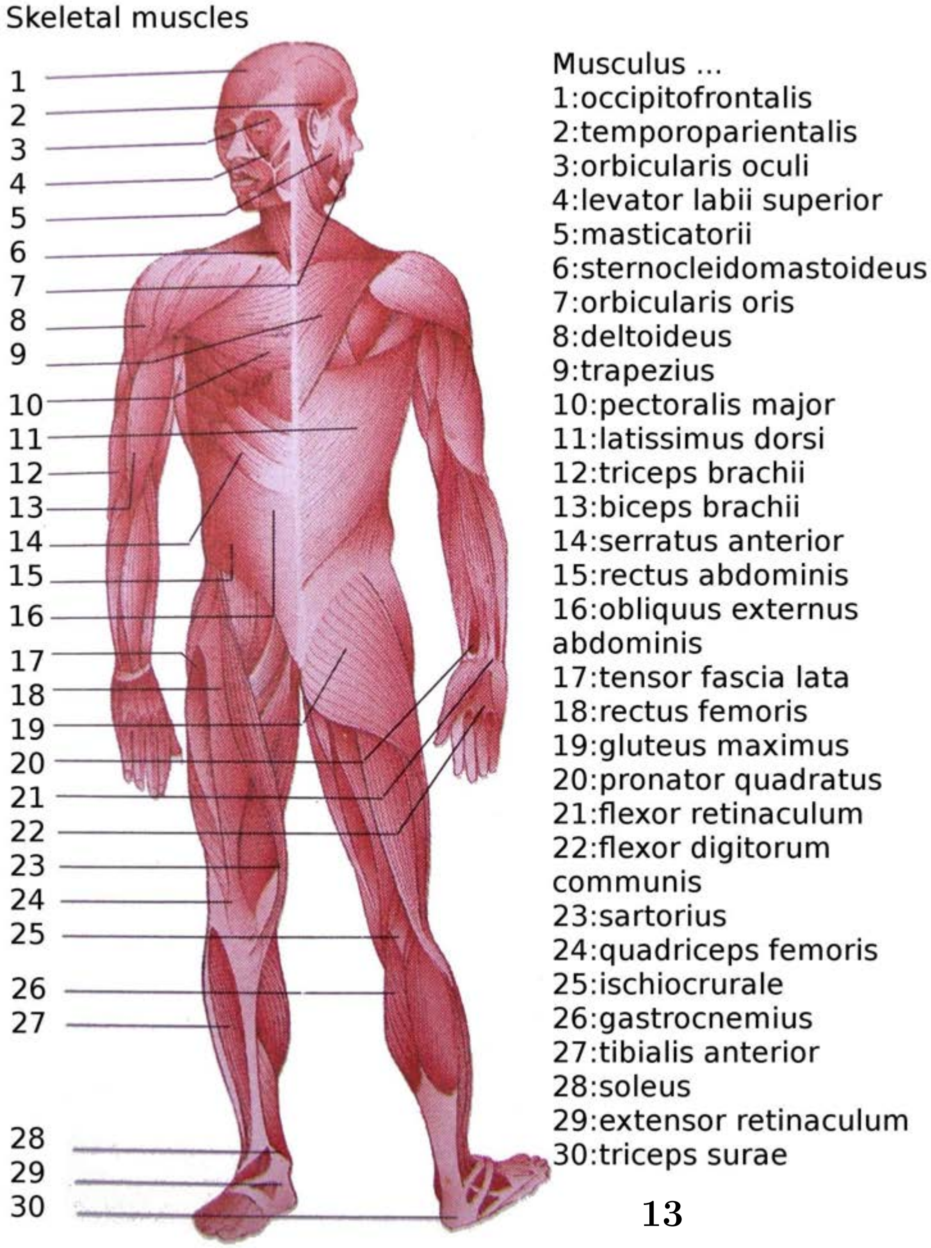


Table 2.1:

Table of muscles of the human body
Table of muscles of the human body: Head˜”0303|˜”0303Table of muscles of the human body: Neck˜”0303|˜”0303Table of muscles of the human body: Torso˜”0303|˜”0303Table of muscles of the human body: Upper limb˜”0303|˜”0303Table of muscles of the human body: Lower limb

This is a **table of muscles of the human anatomy**.

There are approximately 640 skeletal muscles within the typical human, and almost every muscle constitutes one part of a pair of identical bilateralism muscles, found on both sides, resulting in approximately 320 pairs of muscles, as presented in this article. Nevertheless, the exact number is difficult to define because different sources group muscles differently, e.g. regarding what is defined as different parts of a single muscle or as several muscles. Examples range from 640 to 850.

The muscles of the human body can be categorized into a number of groups which include muscles relating to the head and neck, muscles of the torso or trunk, muscles of the upper limbs, and muscles of the lower limbs.

The action refers to the action of each muscle from the standard anatomical terms of location. In other positions, other actions may be performed.

2.1 Muscles of Head and neck anatomy: the head

Scalp/Eyelid

Table 2.2:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
occipitofrontalis muscle	2 occipital bone bellies and 2 frontal bone bellies.	galea aponeurotica		facial nerve	raises the eyebrows	
Occipitalis muscle	superior nuchal line of the occipital bonemastoid part of the temporal bone	galea aponeurotica	occipital artery	posterior auricular nerve (facial nerve)	wrinkles eyebrow	
Frontalis muscle	galea aponeurotica	skin above the eyebrows	ophthalmic artery	facial nerve	wrinkles eyebrow	

Table 2.2: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Orbicularis oculi muscle	frontal bone; medial palpebral ligament; lacrimal bone	lateral palpebral raphe	ophthalmic artery, zygomatico-orbital artery, Angular artery	zygomatic branch of facial nerve and temporal branch of facial nerve	closes eyelids	levator palpebrae superioris muscle
Corrugator supercilii muscle	superciliary arches	forehead skin, near eyebrow		facial nerve	wrinkles forehead	
Depressor supercilii muscle	Medial orbital rim	Medial aspect of bony orbit		facial nerve	Depression of eyebrow	

Extraocular muscles

Table 2.3:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Levator palpebrae superioris muscle	sphenoid bone	tarsal plate, upper eyelid	ophthalmic artery	oculomotor nerve	retracts//Elevation (kinesiology) eyelid	orbicularis oculi muscle
superior tarsal muscle	underside of levator palpebrae superioris	superior tarsal plate of the eyelid	ophthalmic artery	sympathetic nervous system	raise the upper eyelid	

Rectus:

Table 2.4:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Superior rectus muscle	annulus of Zinn at the orbital apex	7.5m̃m superior to the corneal limbus		oculomotor nerve	elevates, adducts, and rotates medially the eye	
Inferior rectus muscle	annulus of Zinn at the orbital apex	6.5m̃m inferior to the corneal limbus		inferior branch of oculomotor nerve	depression (kinesiology) and adduction	

Table 2.4: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Medial rectus muscle	annulus of Zinn at the orbital apex	5.5m̃m medial to the corneal limbus		inferior division of the oculomotor nerve	adducts the eyeball	
Lateral rectus muscle	annulus of Zinn at the orbital apex	7m̃m temporal to the corneal limbus		abducens nerve	Abduction (kinesiology) the human eye	

Oblique:

Table 2.5:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Superior oblique muscle	annulus of Zinn at the orbital apex, medial to optic canal	Outer posterior quadrant of the human eye	lateral muscular branch of the ophthalmic artery	trochlear nerve	primary: intorsion. secondary:Abduction (kinesiology) (laterally rotate) and Depression (kinesiology) the human eye	
Inferior oblique muscle	orbital surface of the maxilla, lateral to the lacrimal groove	laterally onto the human eye, deep to the lateral rectus, by a short flat tendon		oculomotor nerve	extorsion, Elevation (kinesiology), Abduction (kinesiology)	

Human eye

Table 2.6:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
ciliary muscle				oculomotor nerve (parasympathetics)	Accommodation reflex	
Iris dilator muscle				superior cervical ganglion (sympathetic nervous systems)	pupil dilation	iris sphincter muscle
Iris sphincter muscle				short ciliary nerves	constricts pupil	iris dilator muscle

Ear

Table 2.7:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Auriculares muscles	galeal aponeurosis	front of the helix (ear), Anatomical terms of location surface of the pinna (anatomy)		facial nerve	(Wiggle ears)	
temporoparietalis muscle	Auriculares muscles	galea aponeurotica				
stapedius		neck of stapes		facial nerve	control the amplitude of sound to the inner ear	
tensor tympani	Eustachian tube	handle of the malleus	superior tympanic artery	medial pterygoid nerve from mandibular nerve	tensing the tympanic membrane	

Human nose

Table 2.8:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Procerus muscle	From fascia over the lower of the nasal bone	skin of the lower part of the forehead between the eyebrows		Temporal and Lower Zygomatic branch of the facial nerve, (a Buccal branch has also been described)	Draws down the medial angle of the eyebrow giving expressions of frowning	
Nasalis muscle	Maxilla	Nasal bone		Buccal branch of the facial nerve	Compresses bridge, depresses tip of nose, elevates corners of nostrils	

Table 2.9:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
dilator naris muscle	margin of the nasal notch of the maxilla, greater alar cartilage and lesser alar cartilages	skin near the margin of the nostril		Buccal branch of the facial nerve	Dilation of nostrils	

Table 2.10:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Depressor septi nasi muscle	incisive fossa of the maxilla	nasal septum and back part of the alar part of nasalis muscle		Buccal branch of the facial nerve	Depression (kinesiology) of nasal septum	

Table 2.10: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Levator labii superioris alaeque nasi muscle	maxilla	nostril and upper lip		buccal branch of the facial nerve	dilates the nostril; Elevation (kinesiology) the upper lip and wing of the nose	

Mouth

Table 2.11:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
levator anguli oris	maxilla	Modiolus (face)	facial artery	facial nerve	smile (Elevation (kinesiology) angle of mouth)	
Depressor anguli oris muscle	Tubercle (anatomy) of human mandible	Modiolus (face)	facial artery	mandibular branch of facial nerve	Depression (kinesiology) angle of mouth	

Table 2.12:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
levator labii superioris	Medial infra-orbital margin	Skin and muscle of the upper lip (labii superioris)	facial artery	buccal branch of the facial nerve	Elevation (kinesiology) the upper lip	
Depressor labii inferioris muscle	oblique line of the human mandible, between the symphysis and the mental foramen	integument of the lower lip, Orbicularis oris muscle fibers, its fellow of the opposite side		facial nerve	Depression (kinesiology) the lower lip	

Zygomaticus:

Table 2.13:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Zygomaticus major muscle	anatomical terms of location of	Modiolus (face) of mouth	facial artery	buccal branch of the facial nerve	draws angle of mouth upward and laterally	
Zygomaticus minor muscle	zygomatic bone	skin of the upper lip	facial artery	facial nerve, buccal branch of the facial nerve	elevates upper lip	

Table 2.14:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
mentalis	anatomical terms of location human mandible	chin		mandibular branch of facial nerve	elevates and wrinkles skin of chin, protrudes lower lip	
Buccinator muscle	alveolar process of maxilla of the maxillary bone and human mandible, pterygomandibular raphe	in the fibres of the orbicularis oris	buccal artery	buccal branch of the facial nerve	compress the cheeks against the teeth (blowing), mastication.	
Orbicularis oris muscle	Maxilla and human mandible	Skin around the lips		buccal branch of the facial nerve	pucker the lips	
risorius	parotid fascia	modiolus (face)	facial artery	Buccal branch of the facial nerve	draw back angle of mouth	

Mastication

Table 2.15:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
masseter muscle	zygomatic arch and maxilla	coronoid process of the mandible and ramus of mandible	masseteric artery	masseteric nerve (V3)	Elevation (kinesiology) (as in closing of the mouth) and Retraction (kinesiology) of human mandible	Platysma muscle
Temporalis muscle	temporal lines on the parietal bone of the skull	Coronoid process of the mandible of the human mandible	deep temporal arteries	third branch (mandibular nerve) of the trigeminal nerve	Elevation (kinesiology) and Retraction (kinesiology) of human mandible	Platysma muscle

Pterygoid:

Table 2.16:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Lateral pterygoid muscle	Great wing of sphenoid and pterygoid plate	Condyloid process	pterygoid branches of maxillary artery	external pterygoid nerve from the mandibular nerve	Depression (kinesiology) human mandible	
Medial pterygoid muscle	*deep head:* medial side of lateral pterygoid plate behind the upper teeth*superficial head:* pyramidal process of palatine bone and maxillary tuberosity	medial angle of the mandible	pterygoid branches of maxillary artery	mandibular nerve via nerve to medial pterygoid	Elevation (kinesiology) mandible, closes jaw, helps Lateral pterygoid muscle in moving the jaw from side to side	

Tongue

Extrinsic

Table 2.17:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
genioglossus	Superior part of mental spine of human mandible (symphysis menti)	Dorsum of tongue and body of hyoid	Lingual artery	hypoglossal nerve	Complex - Inferior fibers protrude the tongue, middle fibers depress the tongue, and its superior fibers draw the tip back and down	
hyoglossus	hyoid	side of the tongue		hypoglossal nerve	depresses tongue	
chondroglossus	lesser cornu and body of the hyoid bone	intrinsic muscular fibers of the tongue		hypoglossal nerve	depresses tongue (some consider this muscle to be part of hyoglossus)	
styloglossus	styloid process (temporal)	tongue		Hypoglossal nerve	elevates and retracts tongue	inferior and middle fibers of genioglossus

Intrinsic

Table 2.18:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
superior longitudinal muscle	close to the epiglottis, from the median fibrous septum	edges of the tongue		hypoglossal nerve		
transversus muscle	median fibrous septum	sides of the tongue		hypoglossal nerve		
inferior longitudinal muscle	root of the tongue	apex of the tongue		Hypoglossal nerve		

Soft palate

Table 2.19:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
levator veli palatini	temporal bone, Eustachian tube	palatine aponeurosis	facial artery	vagus nerve	elevates soft palate	
tensor veli palatini muscle	medial pterygoid plate of the sphenoid bone	palatine aponeurosis		Medial pterygoid nerve of mandibular nerve	tension (mechanics) of the soft palate	
musculus uvulae	hard palate	palatine aponeurosis				
Palatoglossus muscle	palatine aponeurosis	tongue		vagus nerve and cranial accessory nerve	raising the back part of the tongue	
palatopharyngeus muscle	palatine aponeurosis and hard palate	Upper border of thyroid cartilage (blends with constrictor fibers)	Facial artery	vagus nerve and Accessory nerve	pulls pharynx and larynx	

Pharynx

Pharyngeal constrictor:

Table 2.20:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
inferior pharyngeal constrictor muscle	cricoid and thyroid cartilage	pharyngeal raphe		external laryngeal nerve branch of the vagus	Swallowing	
middle pharyngeal constrictor muscle	hyoid bone	pharyngeal raphe		Vagus nerve	Swallowing	
superior pharyngeal constrictor muscle	medial pterygoid plate, pterygomandibular raphé, alveolar process of maxilla	pharyngeal raphe, pharyngeal tubercle		Vagus nerve	Swallowing	

Table 2.21:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
stylopharyngeus muscle	Styloid process (temporal)	thyroid cartilage (pharynx)		glossopharyngeal nerve	elevate the larynx, elevate the pharynx, swallowing	
salpingopharyngeus muscle	cartilage of the Eustachian tube	posterior muscle fascicle of the pharyngopalatinus muscle		vagus nerve and Accessory nerve	raise the nasopharynx	

Larynx

Table 2.22:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
cricothyroid muscle	Anterior and lateral cricoid	Inferior cornu and lamina of the thyroid cartilage		external laryngeal nerve branch of the vagus	tension and elongation of the vocal folds (has minor adductory effect)	

Cricoarytenoid:

Table 2.23:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
posterior cricoarytenoid muscle	posterior part of the cricoid	muscular process of the arytenoid cartilage		recurrent laryngeal nerve branch of the vagus	Abduction (kinesiology) and laterally rotates the cartilage, pulling the vocal ligaments away from the midline and forward and so opening the rima glottidis	Lateral cricoarytenoid muscle
lateral cricoarytenoid muscle	lateral part of the arch of the cricoid	muscular process of the arytenoid cartilage		recurrent laryngeal nerve branch of the vagus	Adduction and medially rotate the cartilage, pulling the vocal ligaments towards the midline and backwards and so closing off the rima glottidis	

Table 2.24:

Muscle	**Origin**	**Insertion**	**Artery**	**Nerve**	**Action**	**Antagonist**
arytenoid muscle	Arytenoid cartilage on one side	Arytenoid cartilage on opposite side		recurrent laryngeal nerve branch of the vagus	approximate the arytenoid cartilages (close rima glottidis)	
thyroarytenoid muscle	Inner surface of the thyroid cartilage (anterior aspect)	Anterior surface of arytenoid cartilage		recurrent laryngeal nerve branch of the vagus	thickens the vocal folds and decreases length; also helps helps to Adduction the vocal folds during Manner of articulation	

2.2 Muscles of Head and neck anatomy: the neck

Cervical

Table 2.25:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Platysma muscle	inferior clavicle and fascia of chest	human mandible		cervical branch of the facial nerve (CN VII)	Draws the corners of the mouth inferiorly and widens it (as in expressions of sadness and fright). Also draws the skin of the neck Anatomical terms of location#Superior and inferior when teeth are clenched	Masseter muscle, Temporalis muscle
Sternocleidomastoid muscle	manubrium sterni, medial portion of the clavicle	mastoid process of the temporal bone, superior nuchal line	occipital artery and the superior thyroid artery	motor: accessory nervesensory: cervical plexus	Acting alone, tilts head to its own side and rotates it so the face is turned towards the opposite side. Acting together, flexes the neck, raises the sternum and assists in forced inspiration.	

Suprahyoid muscles

Table 2.26:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Digastric muscle	anterior belly - digastric fossa (human mandible); posterior belly - mastoid process of temporal bone	Intermediate tendon (hyoid bone)		anterior belly - mandibular division of the trigeminal (CN V) via the mylohyoid nerve; posterior belly - facial nerve (CN VII)	Opens the jaw when the masseter and the temporalis are relaxed.	
Stylohyoid muscle	styloid process (temporal)	greater cornu of hyoid bone		facial nerve (CN VII)	Elevate the hyoid during swallowing	
Mylohyoid muscle	Mylohyoid line (human mandible)		mylohyoid branch of inferior alveolar artery	mylohyoid nerve, from inferior alveolar nerve]	Raises oral cavity floor, elevates hyoid, Depression (kinesiology) human mandible	
Geniohyoid muscle	Symphysis menti	hyoid bone		cervical spinal nerve 1 via hypoglossal nerve	carry hyoid bone and the tongue upward during Swallowing	

Infrahyoid muscles

Table 2.27:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Sternohyoid muscle	manubrium of Human sternum	hyoid bone		ansa cervicalis	Depression (kinesiology) hyoid bone	
Sternothyroid muscle	manubrium	thyroid cartilage		Ansa cervicalis	Elevates larynx, may slightly depress hyoid bone	

Table 2.27: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Thyrohyoid muscle	thyroid cartilage	hyoid bone		first cervical nerves	Depression (kinesiology) hyoid bone	
Omohyoid muscle	Upper border of the scapula	Hyoid bone		Ansa cervicalis	Depresses the larynx and hyoid bone. Carries hyoid bone backward and to the side	

Vertebral

Anterior

Table 2.28:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Longus colli muscle	Transverse processes of C-3 - C-6	Inferior surface of the occipital bone		cervical spinal nerve 2, cervical spinal nerve 3, cervical spinal nerve 4, cervical spinal nerve 5, cervical spinal nerve 6	Flexes the neck and head	
Longus capitis muscle	anterior tubercles of the transverse processes of the third, fourth, fifth, and sixth cervical vertebrae	basilar artery part of the occipital bone		cervical spinal nerve 1, cervical spinal nerve 2, cervical spinal nerve 3/cervical spinal nerve 4	flexion of neck at atlanto-occipital joint	

Table 2.28: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Rectus capitis anterior muscle	Atlas (anatomy)	occipital bone		cervical spinal nerve 1	flexion of neck at atlanto-occipital joint	
Rectus capitis lateralis muscle	upper surface of the transverse process of the atlas (anatomy)	under surface of the jugular process of the occipital bone		cervical spinal nerve 1	Sidebend at atlanto-occipital joint	

Lateral

Table 2.29:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
scalene muscles	cervical vertebrae (cervical vertebrae-cervical vertebrae)	first and second ribs	Ascending cervical artery (branch of Inferior thyroid artery)	cervical nerves (cervical spinal nerve 3, cervical spinal nerve 4, cervical spinal nerve 5, cervical spinal nerve 6, cervical spinal nerve 7	elevation of ribs I&II	

Table 2.30:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Scalenus anterior	cervical vertebrae-cervical vertebrae	first rib	Ascending cervical artery (branch of Inferior thyroid artery)	ventral ramus of cervical spinal nerve 5, cervical spinal nerve 6		

Table 2.30: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Scalenus medius	cervical vertebrae-cervical vertebrae	first rib	Ascending cervical artery (branch of Inferior thyroid artery)	Ventral rami of the third to eighth cervical spinal nerves	Elevate 1st rib, rotate the neck to the opposite side	
Scalenus posterior	transverse processes of cervical vertebrae - cervical vertebrae	2nd rib	Ascending cervical artery, superficial cervical artery	cervical spinal nerve 6, cervical spinal nerve 7, cervical spinal nerve 8	Elevate 2nd rib, tilt the neck to the same side	

2.3 Muscles of torso

Human back

Splenius muscles:

Table 2.31:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Splenius capitis muscle	Ligamentum nuchae, spinous process of cervical vertebrae-thoracic vertebrae	Mastoid process of temporal and occipital bone		cervical spinal nerve 3, cervical spinal nerve 4	Extend, rotate, and laterally flex the head	
Splenius cervicis muscle	spinous processes of thoracic vertebrae-thoracic vertebrae	transverse processes of Atlas (anatomy), Axis (anatomy), cervical vertebra 3		cervical spinal nerve 5, cervical spinal nerve 6		

Table 2.32:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
erector spinae	on the spines of the last four thoracic vertebræ	both the spines of the most cranial thoracic vertebrae and the cervical vertebrae	lateral sacral artery	posterior branch of spinal nerve	extends the vertebral column	Rectus abdominis muscle

Table 2.33:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
iliocostalis		lateral sacral artery				
longissimus	transverse process	transverse process	lateral sacral artery	posterior branch of spinal nerve		Rectus abdominis muscle
spinalis	spinous process	spinous process	lateral sacral artery	posterior branch of spinal nerve		Rectus abdominis muscle

Table 2.34:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Latissimus dorsi muscle	spinous processes of human thorax thoracic vertebrae-thoracic vertebrae, thoracolumbar fascia, iliac crest and inferior 3 or 4 ribs	floor of intertubercular groove of the humerus	subscapular artery, dorsal scapular artery	thoracodorsal nerve	pulls the forelimb dorsum (biology) and caudally	Deltoid muscle, Trapezius muscle
Transversospinales muscles	transverse process	spinous process		Posterior branch of spinal nerve		

Table 2.35:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
semispinalis dorsi	transverse processes of the sixth to the tenth thoracic vertebræ	spinous processes of the upper four thoracic and lower two cervical vertebrae				
semispinalis cervicis	transverse processes of the upper five or six thoracic vertebræ	cervical spinous processes, from the axis to the fifth				
Semispinalis capitis	Transversal process of lower cervical and higher thoracal columna	Area between superior and inferior nuchal line		Greater occipital nerve	Extend the head	
Multifidus muscle	Sacrum, Erector spinae Aponeurosis, Posterior superior iliac spine, and Iliac crest	spinous process		Posterior branch of spinal nerve	Stabilizes vertebrae in local movements of vertebral column	
Rotatores muscle	transverse process	spinous process		posterior branch of spinal nerve		

Table 2.36:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Interspinales muscle	Spinous process	Spinous process		Posterior rami of spinal nerves	Extension (kinesiology), flexion and rotation of vertebral column.	

Table 2.36: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Intertransversarii muscle	Transverse process	Transverse process above		Ventral ramus of spinal nerve of spinal nerves	Lateral flexion of torso	

Suboccipital nerve

Rectus capitis posterior:

Table 2.37:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Rectus capitis posterior major muscle	Spinous process of the Axis (anatomy) (cervical vertebrae)	Inferior nucheal line of the occipital bone		Dorsal ramus of spinal nerve of cervical spinal nerve 1 (suboccipital nerve)		
Rectus capitis posterior minor muscle	the tubercle on the posterior arch of the Atlas (anatomy)	the medial part of the inferior nuchal line of the occipital bone and the surface between it and the foramen magnum		a branch of the dorsal primary division of the suboccipital nerve	extension (kinesiology) the head at the neck, but is now considered to be more of a sensory organ than a muscle	

obliquus capitis:

Table 2.38:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Obliquus capitis inferior muscle	spinous process of the Axis (anatomy)	lateral mass of atlas		suboccipital nerve		
Obliquus capitis superior muscle	lateral mass of atlas	lateral half of the inferior nuchal line		suboccipital nerve		

Chest

Table 2.39:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Intercostal muscle	ribs 1-11	ribs 2-12	intercostal arteries	intercostal nerves		

Table 2.40:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
External intercostal muscles			intercostal arteries	intercostal nerves	Inhalation	Internal intercostal muscles
Internal intercostal muscles	rib - inferior border	rib - superior border	intercostal arteries	intercostal nerves	hold ribs steady	External intercostal muscles
Innermost intercostal muscle			intercostal arteries	intercostal nerves		

Table 2.41:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Subcostales muscle	inner surface of one rib	inner surface of the second or third rib above, near its angle		intercostal nerves		

Table 2.41: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Transversus thoracis muscle	costal cartilages of last 3-4 ribs, body of sternum, xiphoid process	ribs/costal cartilages 2-6	intercostal arteries	intercostal nerves	depresses ribs	
Levatores costarum muscle	Transverse processes of cervical vertebrae to thoracic vertebrae vertebrae	Superior surfaces of the ribs immediately inferior to the preceding vertebrae		Dorsal ramus of spinal nerve - cervical spinal nerve 8, thoracic spinal nerve 1, thoracic spinal nerve 2, thoracic spinal nerve 3, thoracic spinal nerve 4, thoracic spinal nerve 5, thoracic spinal nerve 6, thoracic spinal nerve 7, thoracic spinal nerve 8, thoracic spinal nerve 9, thoracic spinal nerve 10, thoracic spinal nerve 11	Assists in Elevation (kinesiology) of the thoracic rib cage	

serratus posterior:

Table 2.42:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Serratus posterior inferior muscle	vertebrae thoracic vertebrae - lumbar vertebrae	the inferior borders of the 9th through 12th ribs	intercostal arteries	intercostal nerves	depress the lower ribs, aiding in exhalation	
Serratus posterior superior muscle	nuchal ligament (or ligamentum nuchae) and the spinous processes of the vertebrae C7 through T3	the upper borders of the 2nd through 5th ribs	intercostal arteries	2nd through 5th intercostal nerves	elevate the ribs which aids in inhalation	

Table 2.43:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Thoracic diaphragm			Pericardiacophrenic artery, Musculophrenic artery, Inferior phrenic arteries	Phrenic nerve and lower intercostal nerves	Respiration (physiology)	

Human abdomen

obliques:

Table 2.44:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Abdominal external oblique muscle	Lower 8 Rib	Iliac crest, ligamentum inguinale		intercostal nerves thoracic spinal nerve 5, thoracic spinal nerve 6, thoracic spinal nerve 7, thoracic spinal nerve 8, thoracic spinal nerve 9, thoracic spinal nerve 10, thoracic spinal nerve 11, subcostal nerve (thoracic spinal nerve 12)	Rotates torso	
Abdominal internal oblique muscle	Inguinal ligament, Iliac crest and the Lumbodorsal fascia	Linea alba (abdomen), Xiphoid process and the inferior ribs.		intercostal nerves thoracic spinal nerve 8, thoracic spinal nerve 9, thoracic spinal nerve 10, thoracic spinal nerve 11, subcostal nerve (thoracic spinal nerve 12), iliohypogastric nerve, ilioinguinal nerve	Compresses abdomen and rotates vertebral column.	

Table 2.45:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Transversus abdominis muscle	ribs and the iliac crest	inserts into the pubis (bone) via the conjoint tendon, also known as the falx inguinalis		intercostal nerves thoracic spinal nerve 7, thoracic spinal nerve 8, thoracic spinal nerve 9, thoracic spinal nerve 10, thoracic spinal nerve 11, subcostal nerve (thoracic spinal nerve 12), iliohypogastric nerve, ilioinguinal nerve, genitofemoral nerve	compress the ribs and viscera, providing thoracic and pelvic stability	
Rectus abdominis muscle	pubis (bone)	Costal cartilages of ribs 5-7, xiphoid process of Human sternum	inferior epigastric artery	segmentally by thoracoabdominal nerves (thoracic spinal nerve 7, thoracic spinal nerve 8, thoracic spinal nerve 9, thoracic spinal nerve 10, thoracic spinal nerve 11, thoracic spinal nerve 12)	flexion of torso/lumbar vertebrae	Erector spinae
Pyramidalis muscle	pubic symphysis and pubic crest	linea alba (abdomen)		Subcostal nerve (thoracic spinal nerve 12)	tensing the linea alba (abdomen)	

Table 2.45: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Cremaster muscle	inguinal ligament		Cremasteric artery	genital branch of genitofemoral nerve	raise and lower the scrotum	
Quadratus lumborum muscle	iliac crest and iliolumbar ligament	Last rib and transverse processes of lumbar vertebrae	Lumbar arteries, Iliolumbar artery	Anterior branches of thoracic spinal nerve 12, lumbar spinal nerve 1, lumbar spinal nerve 2, lumbar spinal nerve 3, lumbar spinal nerve 4	Alone, lateral flexion of vertebral column; Together, Depression (kinesiology) of thoracic rib cage	

human pelvis

levator ani:

Table 2.46:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Coccygeus muscle	Sacrospinous ligament			sacral nerves: sacral spinal nerve 4, sacral spinal nerve 5 or sacral spinal nerve 3-S4	closing in the back part of the outlet of the human pelvis	

Perineum

sphincter ani:

Table 2.47:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Sphincter ani externus muscle				sacral spinal nerve 4 and twigs from inferior anal nerves of pudendal nerve	keep the anal canal and anus closed, aids in the expulsion of the feces	
Sphincter ani internus muscle				pudendal nerve	keep the anal canal and anus closed, aids in the expulsion of the feces	

superficial perineal pouch:

Table 2.48:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Transversus perinei superficialis muscle	anterior part of ischial tuberosity	central point of perineum		pudendal nerve		
Bulbospongiosus muscle			Perineal artery	pudendal nerve	in males, empties the urethra; in females, clenches the vagina	
Ischiocavernosus muscle			Perineal artery	pudendal nerve	assists the bulbospongiosus muscle	

deep perineal pouch:

Table 2.49:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
transversus perinei profundus muscle	inferior rami of the ischium	its fellow of the opposite side	pudendal nerve			
Sphincter urethrae	junction of the inferior of the pubis (bone) and ischium to the extent of 1.25 to 2̆cm., and from the neighboring fasciæ	its fellow of the opposite side		perineal branch of the pudendal nerve (sacral spinal nerve 2, sacral spinal nerve 3, sacral spinal nerve 4)	Constricts urethra, maintain urinary continence	

2.4 Muscles of upper limbs

Vertebral column

Table 2.50:

Muscle	**Origin**	**Insertion**	**Artery**	**Nerve**	**Action**	**Antagonist**
Trapezius muscle	down the midline, from the external occipital protuberance, the nuchal ligament, the *medial* part of the nuchal lines, and the spinous processes of the vertebrae C7-T12	at the shoulders, into the *lateral* third of the clavicle, the acromion process and into the spine of the scapula	transverse cervical artery	major nerve supply is the Accessory nerve. Cervical nerves cervical spinal nerve 3 and cervical spinal nerve 4 receive information about pain in this muscle	Descending (superior) part elevates; ascending (inferior) part depresses; and middle part (or all parts together) retracts scapula; descending and ascending parts act together to rotate glenoid cavity superiorly	Serratus anterior muscle
Latissimus dorsi muscle	spinous processes of human thorax thoracic vertebrae-thoracic vertebrae, thoracolumbar fascia, iliac crest and inferior 3 or 4 ribs	floor of intertubercular groove of the humerus	subscapular artery, dorsal scapular artery	thoracodorsal nerve (cervical spinal nerve 6 to cervical spinal nerve 8)	pulls the forelimb dorsum (biology) and caudally	Deltoid muscle, Trapezius muscle
rhomboid muscles	nuchal ligaments, spinous processes of C7-T5 vertebrae	medial border of the scapula	dorsal scapular artery	dorsal scapular nerve (cervical spinal nerve 4 and cervical spinal nerve 5)	Retraction (kinesiology) the scapula and rotates it to Depression (kinesiology) the glenoid cavity. fixes the scapula to the thoracic wall.	Serratus anterior muscle

Table 2.51:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
rhomboid major muscle	spinous processes of the thoracic vertebrae to thoracic vertebra 5 vertebrae	medial border of the scapula, inferior to the insertion of rhomboid minor muscle	dorsal scapular artery	dorsal scapular nerve (cervical spinal nerve 4 and cervical spinal nerve 5)	Retraction (kinesiology) the scapula and rotates it to Depression (kinesiology) the glenoid cavity. It also fixes the scapula to the thoracic wall.	Serratus anterior muscle
rhomboid minor muscle	nuchal ligaments and spinous processes of C7- to thoracic vertebrae vertebrae	medial border of the scapula, superior to the insertion of rhomboid major muscle	dorsal scapular artery	dorsal scapular nerve (cervical spinal nerve 4 and cervical spinal nerve 5)	Retraction (kinesiology) the scapula and rotates it to Depression (kinesiology) the glenoid cavity. It also fixes the scapula to the thoracic wall.	Serratus anterior muscle

Table 2.52:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
levator scapulae muscle	Posterior tubercles of transverse processes of cervical spinal nerve 1 - cervical vertebrae vertebrae	Superior part of medial border of scapula	dorsal scapular artery	cervical nerves (cervical spinal nerve 3, cervical spinal nerve 4) and dorsal scapular nerve (cervical spinal nerve 5)	Elevation (kinesiology) scapula and tilts its glenoid cavity inferiorly by rotating scapula	

Thoracic cavity

Table 2.53:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
pectoralis major muscle	anterior surface of the medial half of the clavicle.**Sternocostal head**: anterior surface of the Human sternum, the superior six costal cartilages	intertubercular groove of the humerus	pectoral branch of the thoracoacromial trunk	lateral pectoral nerve and medial pectoral nerve**Clavicular head**: cervical spinal nerve 5 and cervical spinal nerve 6**Sternocostal head**: cervical spinal nerve 7, cervical spinal nerve 8 and thoracic spinal nerve 1	**Clavicular head**: flexes the humerus**Sternocostal head**: extension (kinesiology) the humerusAs a whole, adducts and medially rotates the humerus. It also draws the scapula anteriorly and inferiorly.	
pectoralis minor muscle	3rd to 5th ribs, near their costal cartilages	medial border and superior surface of the coracoid process of the scapula	Pectoral branch of the thoracoacromial trunk	Medial pectoral nerves (cervical spinal nerve 8, thoracic spinal nerve 1)	stabilizes the scapula by drawing it inferiorly and anteriorly against the thoracic wall	
subclavius muscle	first rib	subclavian groove of clavicle	thoracoacromial artery, clavicular branch	nerve to subclavius	Depression (kinesiology) clavicle	
serratus anterior muscle	fleshy slips from the outer surface of upper 8 or 9 ribs	Rib aspect of medial margin of the scapula	lateral thoracic artery (upper part), thoracodorsal artery (lower part)	long thoracic nerve (from roots of brachial plexus cervical spinal nerve 5, cervical spinal nerve 6, cervical spinal nerve 7)	protract and stabilize scapula, assists in upward rotation	Rhomboid major muscle, Rhomboid minor muscle, Trapezius muscle

Shoulder

Table 2.54:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
deltoid muscle	clavicle, acromion, spine of the scapula	deltoid tuberosity of humerus	primarily posterior circumflex humeral artery	Axillary nerve	shoulder Abduction (kinesiology), flexion and Extension (kinesiology)	Latissimus dorsi
teres major muscle	posterior aspect of the Inferior angle of the scapula of the scapula	medial lip of the intertubercular sulcus of the humerus	Subscapular Artery and circumflex scapular artery arteries	Lower subscapular nerve (segmental levels cervical spinal nerve 5 and cervical spinal nerve 6)	Internal rotation of the humerus	
Rotator cuff:	Various aspects of scapula	greater tubercle of humerus, except subscapularis, which inserts on lesser tubercle of humerus.			lateral rotation (infraspinatus & teres minor), medial rotation (subscapularis), abduction (supraspinatus)	

Table 2.55:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
supraspinatus muscle	supraspinous fossa of scapula	superior facet of greater tubercle of humerus	suprascapular artery	suprascapular nerve	Abduction (kinesiology) of arm and stabilizes humerus	infraspinatus, teres minor, pectoralis major, and latissimus dorsi

Table 2.55: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
infraspinatus muscle	infraspinous fossa of the scapula	middle facet of greater tubercle of the humerus	suprascapular and circumflex scapular artery	suprascapular nerve	Lateral rotation of arm & Adduction of arm and stabilizes humerus	subscapularis, pectoralis major, and latissimus dorsi
teres minor muscle	lateral border of the scapula	inferior facet of greater tubercle of the humerus	posterior circumflex humeral artery and the circumflex scapular artery	axillary nerve	laterally rotates and adducts the arm	subscapularis, pectoralis major, and latissimus dorsi
subscapularis muscle	subscapular fossa	lesser tubercle of humerus	subscapular artery	upper subscapular nerve, lower subscapular nerve (cervical spinal nerve 5, cervical spinal nerve 6)	rotates medially humerus; stabilizes shoulder	infraspinatus and teres minor

Arm

Anterior compartment of the arm

Table 2.56:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
coracobrachialis muscle	coracoid process of scapula	medial humerus	brachial artery	musculocutaneous nerve	adducts humerus	

Table 2.56: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
biceps brachii muscle	**short head:** coracoid process of the scapula. **long head:** supraglenoid tubercle	radial tuberosity	brachial artery	Musculocutaneous nerve (Lateral cord: cervical spinal nerve 5, cervical spinal nerve 6, cervical spinal nerve 7)	flexes Elbow-joint and supinates forearm	Triceps brachii muscle
brachialis muscle	anterior surface of the humerus, particularly the distal half of this bone	coronoid process of the ulna and the tuberosity of the ulna	radial recurrent artery	musculocutaneous nerve	flexion at elbow	

Posterior compartment of the arm

Table 2.57:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
triceps brachii muscle	**long head:** scapula**lateral head:** posterior humerus**medial head:** posterior humerus	olecranon process of ulna	Profunda brachii	radial nerve	extension (kinesiology) forearm, caput longum adducts shoulder	Biceps brachii muscle

Table 2.57: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
anconeus muscle	Lateral epicondyle of the humerus	lateral surface of the olecranon process and the superior part of the posterior ulna	Profunda brachii, recurrent interosseous artery	radial nerve (cervical spinal nerve 7, cervical spinal nerve 8, and thoracic spinal nerve 1)	partly blended in with the triceps, which it assists in extension (kinesiology) of the forearm. Stabilises the elbow and Abduction (kinesiology) the ulna during pronation.	

Forearm

Anterior compartment of the forearm

Superficial

Table 2.58:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
pronator teres muscle	*humeral head*: medial epicondyle of humerus (common flexor tendon) *ulnar head*: coronoid process of the ulna	radius (bone)	ulnar artery and radial artery	median nerve	pronation of forearm, flexes Elbow-joint	Supinator muscle

Table 2.58: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
flexor carpi radialis muscle	medial epicondyle of humerus (common flexor tendon)	Bases of second and third metacarpal bones	ulnar artery	Median nerve	Flexion and Abduction (kinesiology) at wrist	Extensor carpi radialis brevis muscle, Extensor carpi radialis longus muscle
palmaris longus muscle	medial epicondyle of humerus (common flexor tendon)	palmar aponeurosis	ulnar artery	median nerve	wrist flexor	Extensor carpi radialis brevis muscle, Extensor carpi radialis longus muscle, Extensor carpi ulnaris muscle
flexor carpi ulnaris muscle	medial epicondyle of the humerus (common flexor tendon)	pisiform	ulnar artery	muscular branches of ulnar nerve	flexion and adduction of wrist	Extensor carpi ulnaris muscle
flexor digitorum superficialis muscle	medial epicondyle of the humerus (common flexor tendon), as well as parts of the radius (bone) and ulna.	phalanges	ulnar artery	median nerve	flexor of fingers (primarily at proximal interphalangeal joints)	Extensor digitorum muscle

Deep

Table 2.59:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
pronator quadratus	medial, anterior surface of the ulna	lateral, anterior surface of the radius	anterior interosseous artery	median nerve (anterior interosseous nerve)	pronates the forearm	Supinator muscle
flexor digitorum profundus muscle	ulna	distal phalanges	anterior interosseous artery	median nerve (anterior interosseous nerve), muscular branches of ulnar nerve	flex hand, Interphalangeal articulations of hand	Extensor digitorum muscle
flexor pollicis longus muscle	The middle 2/4 of the surface of the radius and the adjacent interosseus membrane. (Also occasionally a small origin slightly on the medial epicondyle of the humerus of the humerus.)	The base of the distal phalanges of the thumb	Anterior interosseous artery	Anterior interosseous nerve (branch of median nerve) (**cervical spinal nerve 8**, thoracic spinal nerve 1)	Flexion of the thumb	Extensor pollicis longus muscle, Extensor pollicis brevis muscle

Posterior compartment of the forearm

Superficial

- mobile wad:

Table 2.60:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
brachioradialis	Lateral supracondylar ridge of the humerus	Distal radius (Radial styloid process)	radial recurrent artery	radial nerve	Flexion of forearm	

Table 2.60: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
extensor carpi radialis longus muscle	lateral supracondylar ridge	Second metacarpal bone	radial artery	radial nerve	extensor at the wrist joint, Abduction (kinesiology) the hand at the wrist	Flexor carpi radialis muscle
extensor carpi radialis brevis muscle	humerus at the anterior of Lateral epicondyle of the humerus (common extensor tendon)	base of the Third metacarpal bone	radial artery	deep branch of the radial nerve	extensor and Abduction (kinesiology) of the hand at the wrist joint	Flexor carpi radialis muscle

Table 2.61:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
extensor digitorum muscle	Lateral epicondyle of the humerus (common extensor tendon)	2nd through 5th phalanges	interosseous recurrent artery and posterior interosseous artery	posterior interosseous nerve (cervical spinal nerve 7, cervical spinal nerve 8)	Extension (kinesiology) of hand and fingers	Flexor digitorum superficialis muscle, Flexor digitorum profundus muscle
extensor digiti minimi muscle	the anterior portion of the lateral epicondyle of the humerus (common extensor tendon)	extensor expansion, located at the base of the proximal phalanx of the finger on the dorsal side	posterior interosseous artery which originates from the common interosseous artery and more proximally, the ulnar artery	posterior interosseous nerve (cervical spinal nerve 7, cervical spinal nerve 8)	extends the little finger at all joints	Flexor digiti minimi brevis (hand)

Table 2.61: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
extensor carpi ulnaris muscle	Common extensor tendon (Lateral epicondyle of the humerus), ulna	Fifth metacarpal bone	ulnar artery	posterior interosseous nerve (cervical spinal nerve 7, cervical spinal nerve 8)	Extension (kinesiology) and adducts the wrist	Flexor carpi ulnaris

Deep

Table 2.62:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
supinator muscle	Lateral epicondyle of the humerus, supinator crest of ulna, radial collateral ligament (elbow), annular ligament	Lateral proximal radial shaft	radial recurrent artery	posterior interosseous nerve (cervical spinal nerve 7, cervical spinal nerve 8)	supinates forearm	Pronator teres muscle, Pronator quadratus

- anatomical snuff box:

Table 2.63:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
abductor pollicis longus muscle	ulna, radial styloid process	first metacarpal	posterior interosseous artery	posterior interosseous nerve (cervical spinal nerve 7, cervical spinal nerve 8)	Abduction (kinesiology), Extension (kinesiology) of thumb	Adductor pollicis muscle

Table 2.63: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
extensor pollicis brevis muscle	Radius (bone)	thumb, Proximal phalanges	posterior interosseous artery	posterior interosseous nerve (cervical spinal nerve 7, cervical spinal nerve 8)	Extension (kinesiology) of thumb at metacarpophalangeal joint	Flexor pollicis longus muscle, Flexor pollicis brevis muscle
extensor pollicis longus muscle	ulna	thumb, distal phalanges		posterior interosseous nerve (cervical spinal nerve 7, cervical spinal nerve 8)	Extension (kinesiology) of the thumb (metacarpophalangeal and interphalangeal articulations of hand)	Flexor pollicis longus muscle, Flexor pollicis brevis muscle

Table 2.64:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
extensor indicis proprius	ulna	index finger (extensor hood)		posterior interosseous nerve (cervical spinal nerve 7, cervical spinal nerve 8)	extension (kinesiology) index finger, wrist	

Hand

Lateral volar

Thenar eminence

Table 2.65:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
opponens pollicis muscle	Trapezium (bone) and transverse carpal ligament	metacarpal bone of the thumb on its radial side		median nerve	Opposition of the thumb	
flexor pollicis brevis muscle	Trapezoid bone, flexor retinaculum of the hand	thumb, Proximal phalanges		median nerve, deep branch of ulnar nerve (medial head)	Flexion of thumb	Extensor pollicis longus muscle, Extensor pollicis brevis muscle
abductor pollicis brevis muscle	Transverse carpal ligament, the scaphoid and trapezium	Radial base of proximal phalanx of thumb and the s		Median nerve	Abduction of thumb	Adductor pollicis muscle
adductor pollicis muscle	**Transverse head:** anterior body of the third metacarpal**Oblique head:** bases of the second metacarpal and the third metacarpals and the adjacent trapezoid and capitate bones	medial side of the base of the proximal phalanx of the thumb and the ulnar sesamoid		deep branch of ulnar nerve (thoracic spinal nerve 1)	adducts the thumb at the carpometacarpal joint	Abductor pollicis longus muscle, Abductor pollicis brevis muscle

Medial volar

Table 2.66:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
palmaris brevis muscle	Flexor retinaculum of the hand (medial), palmar aponeurosis	Hand		superficial branch of ulnar nerve	wrinkle skin of palm	

Hypothenar eminence :

Table 2.67:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Abductor digiti minimi muscle (hand)	pisiform	base of the proximal phalanx of the Little finger on the ulnar or medial side	ulnar artery	deep branch of ulnar nerve	Abduction of little finger	
Flexor digiti minimi brevis (hand)	hamate bone	little finger	ulnar artery	deep branch of ulnar nerve	flexes little finger	Extensor digiti minimi muscle
opponens digiti minimi muscle	Hook of hamate and flexor retinaculum of the hand	Medial border of 5th metacarpal	ulnar artery	deep branch of ulnar nerve (cervical spinal nerve 8 and thoracic spinal nerve 1)	Draws Fifth metacarpal bone anteriorly and rotates it, bringing little finger (5th digit) into opposition with thumb	

Intermediate

Table 2.68:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Lumbricals of the hand	flexor digitorum profundus	extensor expansion	superficial palmar arch, common palmar digital arteries, deep palmar arch, dorsal metacarpal arteries	deep branch of ulnar nerve, median nerve	Flexion metacarpophalangeal joints, Extension (kinesiology) Interphalangeal articulations of hand	
Dorsal interossei of the hand	metacarpals	proximal phalanges	Dorsal carpal arch and palmar metacarpal artery	deep branch of ulnar nerve	Abduction (kinesiology) finger	Palmar interossei muscles
palmar interossei muscles	metacarpals	proximal phalange		deep branch of ulnar nerve	adduction	

2.5 Muscles of lower limb

Iliac region

Table 2.69:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Iliopsoas	iliac fossa (iliacus muscle, sacrum (iliacus), Vertebral column (thoracic vertebra 12, lumbar vertebra 1, lumbar vertebra 2, lumbar vertebra 3, lumbar vertebra 4, lumbar vertebra 5) & intervertebral discs (Psoas major muscle, Psoas minor muscle)	femur - lesser trochanter (psoas major/minor), shaft below lesser trochanter (iliacus), tendon of psoas major & femur (iliacus)	medial femoral circumflex artery, iliolumbar artery	femoral nerve, Lumbar nerves lumbar spinal nerve 1, lumbar spinal nerve 2	flexion of hip (psoas major/minor, iliacus), spine rotation (psoas major/minor)	Gluteus maximus, posterior compartment of thigh

Table 2.70:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Psoas major muscle	lower spine	in the lesser trochanter of the femur	Iliolumbar artery	Lumbar plexus via anterior branches of lumbar spinal nerve 1, lumbar spinal nerve 2, lumbar spinal nerve 3	flexes and rotates laterally thigh	Gluteus maximus muscle
Psoas minor muscle	Side of thoracic vertebrae+lumbar vertebrae and IV Disc between	and iliopectineal eminence		lumbar spinal nerve 1	Weak trunk flexor	Gluteus maximus muscle

Table 2.70: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
iliacus muscle	iliac fossa	lesser trochanter of femur	medial femoral circumflex artery, Iliolumbar artery	femoral nerve (lumbar spinal nerve 2, lumbar spinal nerve 3)	flexes and rotates laterally thigh	Gluteus maximus muscle

Buttocks

Table 2.71:

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
gluteus maximus muscle	Gluteal surface of ilium (bone), lumbar fascia, sacrum, sacrotuberous ligament	Gluteal tuberosity of the femur, iliotibial tract	superior gluteal artery and inferior gluteal artery	inferior gluteal nerve (lumbar spinal nerve 5, sacral spinal nerve 1, sacral spinal nerve 2 nerve roots)	external rotation and Extension (kinesiology) of the hip joint, supports the extended knee through the iliotibial tract, chief antigravity muscle in sitting	Iliacus muscle, Psoas major muscle, Psoas minor
gluteus medius muscle	Gluteal surface of ilium (bone), under gluteus maximus	Greater trochanter of the femur	superior gluteal artery	superior gluteal nerve (lumbar spinal nerve 4, lumbar spinal nerve 5, sacral spinal nerve 1 nerve roots)	anatomical terms of location of the hip; preventing anatomical terms of location of the hip. Medial rotation of thigh.	lateral rotator group

Table 2.71: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
gluteus minimus muscle	Gluteal surface of Ilium (bone), under gluteus medius.	Greater trochanter of the femur	superior gluteal artery	superior gluteal nerve (lumbar spinal nerve 4, lumbar spinal nerve 5, sacral spinal nerve 1 nerve roots)	Works in concert with gluteus medius: anatomical terms of location of the hip; preventing anatomical terms of location of the hip. Medial rotation of thigh.	lateral rotator group

Chapter 3

Human musculoskeletal system

A **musculoskeletal system** (also known as the **locomotor system**) is an Organ (anatomy) that gives animals (including humans) the ability to move using the Muscular system and skeletal systems. The musculoskeletal system provides form, support, stability, and movement to the body.

It is made up of the body's bones (the skeleton), muscles, cartilage, tendons, ligaments, joints, and other connective tissue that supports and binds tissues and organs together. The musculoskeletal system's primary functions include supporting the body, allowing motion, and protecting vital organs. The skeletal portion of the system serves as the main storage system for calcium and phosphorus and contains critical components of the hematopoietic system.

This system describes how bones are connected to other bones and muscle fibers via connective tissue such as tendons and ligaments. The bones provide the stability to a body in analogy to iron rods in concrete construction. Muscles keep bones in place and also play a role in movement of the bones. To allow motion, different bones are connected by joints. Cartilage prevents the bone ends from rubbing directly on to each other. Muscles contract (bunch up) to move the bone attached at the joint.

There are, however, diseases and disorders that may adversely affect the function and overall effectiveness of the system. These diseases can be difficult to medical diagnosis due to the close relation of the musculoskeletal system to other internal systems. The musculoskeletal system refers to the system having its muscles attached to an internal skeletal system and is necessary for humans to move to a more favorable position. Complex issues and injuries involving the musculoskeletal system are usually handled by a physiatrist (specialist in Physical Medicine and Rehabilitation) or an orthopaedic surgeon.

3.1 Subsystems

Skeletal

Main article: Human skeleton

The Skeletal System serves many important functions; it provides the shape and form for our bodies in addition to supporting, protecting, allowing bodily movement, producing blood for the body, and storing minerals. The number of bones in the human skeletal system is a controversial topic. Humans are born with about 300 to 350 bones; however, many bones fuse together between birth and maturity. As a result an average adult skeleton consists of 206 bones. The number of bones varies according to the method used to derive the count. While some consider certain structures to be a single bone with multiple parts, others may see it as a single part with multiple bones. There are five general classifications of bones. These are Long bones, Short bones, Flat bones, Irregular bones, and Sesamoid bones. The human skeleton is composed of both fused and individual bones supported by ligaments, tendons, muscles and cartilage. It is a complex structure with two distinct divisions. These are the axial skeleton and the appendicular skeleton.

Function

The Skeletal System serves as a framework for Tissue (biology) and organs to attach themselves to. This system acts as a protective structure for vital organs. Major examples of this are the Human brain being protected by the Human skull and the Human lungs being protected by the rib cage.

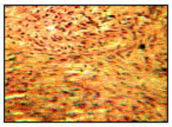
Located in long bones are two distinctions of bone marrow (yellow and red). The yellow marrow has fatty connective tissue and is found in the marrow cavity. During starvation, the body uses the fat in yellow marrow for energy. The red marrow of some bones is an important site for blood cell production, approximately 2.6 million red blood cells per second in order to replace existing cells that have been destroyed by the liver. Here all erythrocytes, platelets, and most leukocytes form in adults. From the red marrow, erythrocytes, platelets, and leukocytes migrate to the blood to do their special tasks.

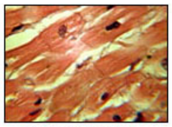
Another function of bones is the storage of certain minerals. Calcium and phosphorus are among the main minerals being stored. The importance of this storage "device" helps to regulate mineral balance in the bloodstream. When the fluctuation of minerals is high, these minerals are stored in bone; when it is low it will be withdrawn from the bone.

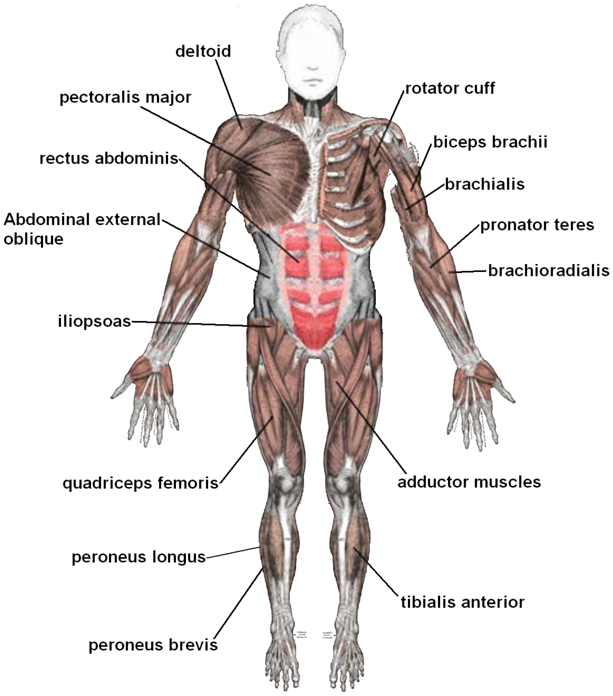
Muscular

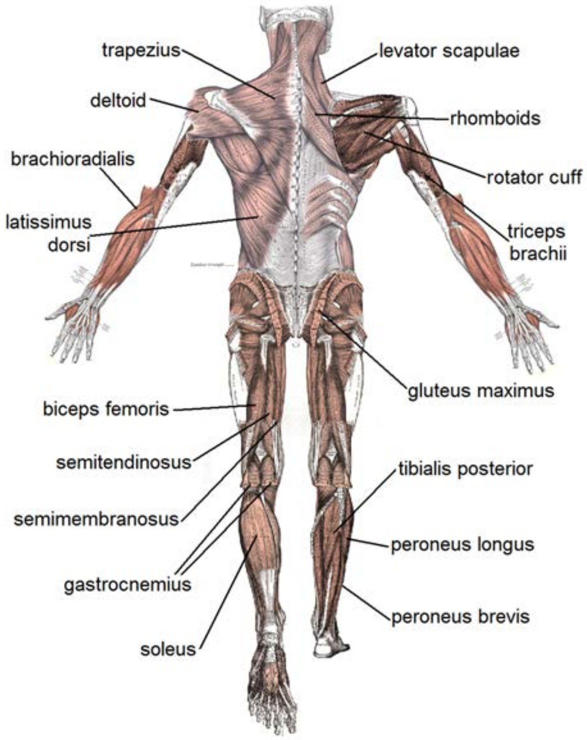
Main article: muscle

Skeletal muscle


Smooth muscle


Cardiac muscle





There are three types of muscles—Cardiac muscle, Skeletal muscle, and Smooth muscle. Smooth muscles are used to control the flow of substances within the lumen (anatomy) of hollow organs, and are involuntary muscle. Skeletal and cardiac muscles have Striated muscle that are visible under a microscope due to the components within their cells. Only skeletal and smooth muscles are part of the musculoskeletal system and only the skeletal muscles can move the body. Cardiac muscles are found in the heart and are used only to circulate blood; like the smooth muscles, these muscles are not under conscious control. Skeletal muscles are attached to bones and arranged in opposing groups around joints. Muscles are innervated, to communicate nervous energy to, by nerves, which conduct electrical currents from the central nervous system and cause the muscles to contract.

Contraction initiation

Main article: muscle contraction In mammals, when a muscle contracts, a series of reactions occur. Muscle contraction is stimulated by the motor neuron sending a message to the muscles from the somatic nervous system. Depolarization of the motor neuron results in neurotransmitters being released from the nerve terminal. The space between the nerve terminal and the muscle cell (biology) is called the neuromuscular junction. These neurotransmitters diffuse across the Chemical synapse and bind to specific receptor sites on the sarcolemma. When enough receptors are stimulated, an action potential is generated and the Semipermeable membrane of the sarcolemma is altered. This process is known as initiation.

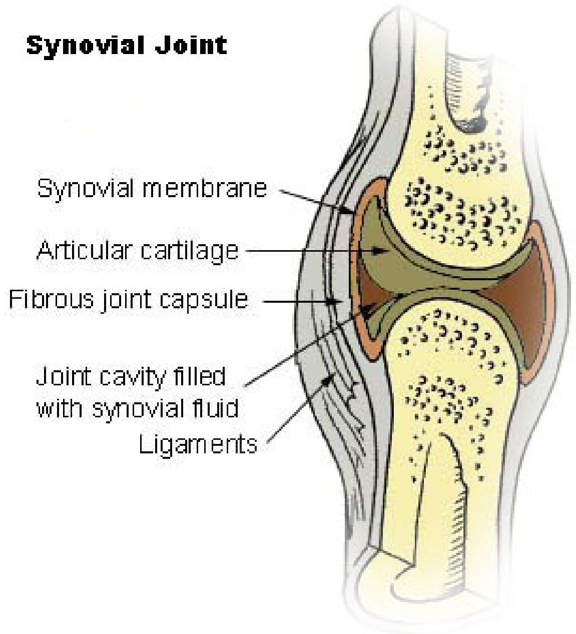
Tendons

Main article: tendon A tendon is a tough, flexible band of fibrous connective tissue that connects muscles to bones. The extra-cellular connective tissue between muscle fibers binds to tendons at the distal & proximal ends, and the tendon binds to the periosteum of individual bones at the muscle's origin & insertion. As muscles contract, tendons transmit the forces to the rigid bones, pulling on them and causing movement. Tendons can stretch substantially, allowing them to function as springs during locomotion, thereby saving energy.

Joints, ligaments, and bursae

Joints

Main article: joint



Joints are structures that connect individual bones and may allow bones to move against each other to cause movement. There are two divisions of joints, Synovial joint which allow extensive mobility between two or more articular heads, and false joints or Synarthrosis, joints that are immovable, that allow little or no movement and are predominantly fibrous. Synovial joints, joints that are not directly joined, are lubricated by a solution called synovial Fluid that is produced by the synovial membranes. This fluid lowers the friction between the articular surfaces and is kept within an articular capsule, binding the joint with its taut tissue.

Ligaments

Main article: ligament A ligament is a small band of dense, white, fibrous elastic tissue. Ligaments connect the ends of bones together in order to form a joint. Most ligaments limit dislocation, or prevent certain movements that may cause breaks. Since they are only elastic they increasingly lengthen when under pressure. When this occurs the ligament may be susceptible to break resulting in an unstable joint.

Ligaments may also restrict some actions: movements such as Extension (kinesiology) and Flexion are restricted by ligaments to an extent. Also ligaments prevent certain directional movement.

Bursa

Main article: bursa (anatomy) A bursa is a small fluid-filled sac made of white fibrous tissue and lined with synovial membrane. Bursa may also be formed by a synovial membrane that extends outside of the joint capsule. It provides a cushion between bones and tendons and/or muscles around a joint; bursa are filled with synovial fluid and are found around almost every major joint of the body.

3.2 Diseases and disorders

Further information: Musculoskeletal disorders,"0303http://en.wikipedia.org/w/index.php?title=RheumatologyRheu
surgeryOrthopedic surgery Because many other body systems, including the Circulatory system, Nervous system, and integumentary systems, are interrelated, disorders of one of these systems may also affect the musculoskeletal system and complicate the diagnosis of the disorder's origin. Diseases of the musculoskeletal system mostly encompass functional disorders or motion discrepancies; the level of impairment depends specifically on the problem and its severity. Articular (of or pertaining to the joints) disorders are the most common. However, also among the diagnoses are: primary muscular diseases, neurologic (related to the medical science that deals with the nervous system and disorders affecting it) deficits, toxins, Endocrine system abnormalities, Metabolism disorders, infectious diseases, blood and vascular disorders, and nutritional imbalances. Disorders of muscles from another body system can bring about irregularities such as: impairment of ocular motion and control, respiratory dysfunction, and bladder malfunction. Complete paralysis, paresis, or ataxia may be caused by primary muscular dysfunctions of infectious or toxic origin; however, the primary disorder is usually related to the nervous system, with the muscular system acting as the effector organ, an organ capable of responding to a stimulus, especially a nerve impulse. One understated disorder that begins during pregnancy is PGP, it is complex and multi-factorial and likely to be also represented by a series of sub-groups driven by pain varying from peripheral or central nervous system, altered laxity/stiffness of muscles, laxity to injury of tendinous/ligamentous structures to 'mal-adaptive' body mechanics.

Chapter 4

Muscular system

The **muscular system** is the anatomical system of a species that allows it to move. The muscular system in vertebrates is controlled through the nervous system, although some muscles (such as the cardiac muscle) can be completely autonomous.

4.1 Muscles

Main article: Muscle There are three distinct types of muscles: skeletal muscles, cardiac or heart muscles, and smooth (non-striated) muscles. Muscles provide strength, balance, posture, movement and heat for the body to keep warm.

Upon stimulation by an action potential, skeletal muscles perform a coordinated contraction by shortening each sarcomere. The best proposed model for understanding contraction is the sliding filament model of muscle contraction. Actin and myosin fibers overlap in a contractile motion towards each other. Myosin filaments have club-shaped heads that project toward the actin filaments.

Larger structures along the myosin filament called Myosin are used to provide attachment points on binding sites for the actin filaments. The myosin heads move in a coordinated style, they swivel toward the center of the sarcomere, detach and then reattach to the nearest active site of the actin filament. This is called a rachet type drive system. This process consumes large amounts of adenosine triphosphate (ATP).

Energy for this comes from **ATP**, the energy source of the cell. ATP binds to the cross bridges between myosin heads and actin filaments. The release of energy powers the swiveling of the myosin head. Muscles store little ATP and so must continuously recycle the discharged adenosine diphosphate molecule (ADP) into ATP rapidly. Muscle tissue also contains a stored supply of a fast acting recharge chemical, creatine phosphate which can assist initially producing the rapid regeneration of ADP into ATP.

Calcium ions are required for each cycle of the sarcomere. Calcium is released from the sarcoplasmic reticulum into the sarcomere when a muscle is stimulated to contract. This calcium uncovers the actin binding sites. When the muscle no longer needs to contract, the calcium ions are pumped from the sarcomere and back into storage in the sarcoplasmic reticulum.

Anatomy

Main article: Table of muscles of the human body There are approximately 639 skeletal muscles in the human body.

The following are some major muscles and their basic features:

Table 4.1:

Muscle	**Origin**	**Insertion**	**Artery**	**Nerve**	**Action**	**Antagonist**
gastrocnemius	femur	calcaneus	sural arteries	tibial nerve	plantarflexion, flexion of knee (minor)key	Tibialis anterior muscle
tibialis posterior muscle	tibia, fibula	Foot	posterior tibial artery	tibial nerve	Inversion (kinesiology), plantar flexion of the foot at the ankle	Tibialis anterior muscle
soleus	tibia, medial border of fibula	calcaneus	sural arteries	tibial nerve	plantarflexion	Tibialis anterior muscle
tibialis anterior muscle	tibia	foot	anterior tibial artery	Deep fibular nerve	dorsiflexion and Inversion (kinesiology) the foot	Fibularis longus, Gastrocnemius muscle, Soleus muscle, Plantaris muscle, Tibialis posterior muscle
Peroneus longus	fibula	Foot	fibular artery	Superficial fibular nerve	plantarflexion, Eversion (kinesiology)	Tibialis anterior muscle
Peroneus brevis	fibula	Foot, Eversion (kinesiology)	peroneal artery	superficial peroneal nerve		
gluteus maximus muscle	ilium (bone), sacrum, sacrotuberous ligament	Gluteal tuberosity of the femur	gluteal arteries	inferior gluteal nerve	external rotation and Extension (kinesiology) of the hip joint	Iliacus muscle, Psoas major muscle, Psoas minor

Table 4.1: (continued)

Muscle	**Origin**	**Insertion**	**Artery**	**Nerve**	**Action**	**Antagonist**
biceps femoris muscle	ischium, femur	fibula	inferior gluteal artery, popliteal artery	tibial nerve, common peroneal nerve	Flexion and laterally rotates knee joint, Extension (kinesiology) hip joint	Quadriceps muscle
semitendinosus muscle	ischium	tibia	inferior gluteal artery	sciatic nerve	Flexion knee, Extension (kinesiology) hip joint	Quadriceps muscle
semimembranosus muscle	ischium	tibia	profunda femoris, gluteal artery	sciatic nerve	Hip Extension (kinesiology), Knee flexion	Quadriceps muscle
iliopsoas	ilium (bone)	femur	medial femoral circumflex artery, iliolumbar artery	femoral nerve, lumbar nerves	flexion of hip	Gluteus maximus, posterior compartment of thigh
quadriceps femoris muscle	combined rectus femoris and vastus muscles		femoral artery	Femoral nerve	Knee Extension (kinesiology); Hip flexion	Hamstring
adductor muscles of the hip	Pubis (bone)	femur, tibia		obturator nerve	adduction of hip	
levator scapulae muscle	vertebral column	scapula	dorsal scapular artery	cervical nerve, dorsal scapular nerve	Elevation (kinesiology) scapula, tilts its glenoid cavity inferiorly	
Trapezius muscle	the rear of the skull, vertebral column	clavicle, scapula		Accessory nerve, cervical nerves	Retraction (kinesiology) of scapula	Serratus anterior muscle
Rectus abdominis muscle	pubis (bone)	Costal cartilage of ribs 5-7, Human sternum	inferior epigastric artery	segmentally by thoraco-abdominal nerves	flexion of torso/lumbar vertebrae	Erector spinae

Table 4.1: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
Transversus abdominis muscle	ribs, ilium (bone)	pubis (bone)		lower intercostal nerves, iliohypogastric nerve and the ilioinguinal nerve	compress the ribs and viscera, thoracic and pelvic stability	
Abdominal external oblique muscle	Lower 8 costae	Crista iliaca, ligamentum inguinale		lower 6 intercostal nerve, subcostal nerve	Rotates torso	
Abdominal internal oblique muscle	Inguinal ligament, Iliac crest and the Lumbodorsal fascia	Linea alba (abdomen), Human sternum and the inferior ribs.			Compresses abdomen and rotates vertebral column.	
erector spinae	on the spines of the last four thoracic vertebræ	both the spines of the most cranial thoracic vertebrae and the cervical vertebrae	lateral sacral artery	posterior branch of spinal nerve	extends the vertebral column	Rectus abdominis muscle
pectoralis major muscle	clavicle, Human sternum, costal cartilages	humerus	thoracoacromial trunk	lateral pectoral nerve and medial pectoral nerve	**Clavicular head**: flexes the humerus**Sternocostal head**: Extension (kinesiology) the humerus As a whole, adducts and medially rotates the humerus. It also draws the scapula anteriorly and inferiorly.	

Table 4.1: (continued)

Muscle	Origin	Insertion	Artery	Nerve	Action	Antagonist
biceps brachii muscle	scapula	radius (bone)	brachial artery	Musculocutaneous nerve	flexes Elbow-joint and supinates forearm	Triceps brachii muscle
triceps brachii muscle	scapula and humerus	ulna	deep brachial artery	radial nerve	Extension (kinesiology) forearm, caput longum adducts shoulder	Biceps brachii muscle
brachialis muscle	humerus	ulna	radial recurrent artery	musculocutaneous nerve	flexion at elbow	
pronator teres muscle	humerus, ulna	radius (bone)	ulnar artery and radial artery	median nerve	pronation of forearm, flexes Elbow-joint	Supinator muscle
brachioradialis	humerus	radius (bone)	radial recurrent artery	radial nerve	Flexion of forearm	
rhomboid muscles	nuchal ligaments, spinous processes of the C7 to T5 vertebrae	scapula	dorsal scapular artery	dorsal scapular nerve	Retraction (kinesiology) the scapula and rotates it to Depression (kinesiology) the glenoid cavity. fixes the scapula to the thoracic wall.	Serratus anterior muscle
deltoid muscle	clavicle, acromion, scapula	deltoid tuberosity of humerus	primarily posterior circumflex humeral artery	Axillary nerve	shoulder Abduction (kinesiology), flexion and Extension (kinesiology)	Latissimus dorsi
Latissimus dorsi muscle	vertebral column, ilium (bone) and inferior 3 or 4 ribs	humerus	subscapular artery, dorsal scapular artery	thoracodorsal nerve	pulls the forelimb dorsally and caudally	Deltoid muscle, Trapezius muscle

Aerobic and anaerobic muscle activity

At rest, the body produces the majority of its Adenosine triphosphate aerobically in the mitochondria without producing lactic acid or other fatiguing byproducts. During exercise, the method of ATP production varies depending on the fitness of the individual as well as the duration, and intensity of exercise. At lower activity levels, when exercise continues for a long duration (several minutes or longer), energy is produced aerobically by combining oxygen with carbohydrates and fats stored in the body. Activity that is higher in intensity, with possible duration decreasing as intensity increases, ATP production can switch to anaerobic pathways, such as the use of the Phosphocreatine and the phosphagen system or anaerobic glycolysis. Aerobic ATP production is biochemically much slower and can only be used for long-duration, low intensity exercise, but produces no fatiguing waste products that can not be removed immediately from sarcomere and body and results in a much greater number of ATP molecules per fat or carbohydrate molecule. Aerobic training allows the oxygen delivery system to be more efficient, allowing aerobic metabolism to begin quicker. Anaerobic ATP production produces ATP much faster and allows near-maximal intensity exercise, but also produces significant amounts of lactic acid which render high intensity exercise unsustainable for greater than several minutes. The phosphagen system is also anaerobic, allows for the highest levels of exercise intensity, but intramuscular stores of phosphocreatine are very limited and can only provide energy for exercises lasting up to ten seconds. Recovery is very quick, with full creatine stores regenerated within five minutes.

Cardiac muscle

Main article: Heart muscle Heart muscles are distinct from skeletal muscles because the muscle fibers are laterally connected to each other. Furthermore, just as with smooth muscles, they are not controlling themselves. Heart muscles are controlled by the sinus node influenced by the autonomic nervous system.

Smooth muscle

Main article: Smooth muscle Smooth muscles are controlled directly by the autonomic nervous system and are involuntary, meaning that they are incapable of being moved by conscious thought. Functions such as heart beat and lungs (which are capable of being willingly controlled, be it to a limited extent) are involuntary muscles but are not smooth muscles.

4.2 Control of muscle contraction

Neuromuscular junctions are the focal point where a motor neuron attaches to a muscle. Acetylcholine, (a neurotransmitter used in skeletal muscle contraction) is released from the axon terminal of the nerve cell when an action potential reaches the microscopic junction, called a synapse. A group of chemical messengers cross the synapse and stimulate the formation of electrical changes, which are produced in the muscle cell when the acetylcholine binds to receptors on its surface. Calcium is released from its storage area in the cell's sarcoplasmic reticulum. An impulse from a nerve cell causes calcium release and brings about a single, short muscle contraction called a muscle twitch. If there is a problem at the neuromuscular junction, a very prolonged contraction may occur, tetanus. Also, a loss of function at the junction can produce paralysis.

Skeletal muscles are organized into hundreds of motor units, each of which involves a motor neuron, attached by a series of thin finger-like structures called Chemical synapse#Anatomy and physiology. These attach to and control discrete bundles of muscle fibers. A coordinated and fine tuned response to a specific circumstance will involve controlling the precise number of motor units used. While individual muscle units contract as a unit, the entire muscle can contract on a predetermined basis due to the structure of the motor unit. Motor unit coordination, balance, and control frequently come under the direction of the cerebellum of the brain. This allows for complex muscular coordination with little conscious effort, such as when one drives a car without thinking about the process.

4.3 See also

- Major systems of the human body

4.4 References

- Online Muscle Tutorial

Medical and Health Encyclopedia, chapter 1

4.5 External links

- GetBody Smart Muscle system tutorials and quizzes
- MedBio.info Use and formation of ATP in muscle

Chapter 5

Extraocular muscles

The **extraocular muscles** are the six muscles that control the Eye movement (sensory) (there are four in Bovinae). The actions of the extraocular muscles depend on the position of the human eye at the time of muscle contraction.

5.1 List of muscles

See also: Table of muscles of the human body#Extraocular

Table 5.1:

Muscle	Innervation	Origin	Insertion	Primary function	Secondary function	Tertiary function	Inserted into the sclera distance
Superior rectus muscle	Superior branch of oculomotor nerve	Annulus of Zinn from tendinous ring	human eye (anterior, superior surface)	Elevation (kinesiology)	Intorsion	Adduction	7.9mm
Inferior rectus muscle	Inferior branch of oculomotor nerve	Annulus of Zinn from tendinous ring	human eye (anterior, inferior surface)	Depression (kinesiology)	Extorsion	Adduction	6.6mm
Lateral rectus muscle	Abducens nerve	Annulus of Zinn from tendinous ring	human eye (anterior, lateral surface)	Abduction (kinesiology)			7.0mm
Medial rectus muscle	Inferior branch of oculomotor nerve	Annulus of Zinn from tendinous ring	human eye (anterior, medial surface)	Adduction			5.8mm

Table 5.1: (continued)

Muscle	Innervation	Origin	Insertion	Primary function	Secondary function	Tertiary function	Inserted into the sclera distance
Superior oblique muscle	Trochlear nerve	Annulus of Zinn via the Trochlea of superior oblique which forms a 'pulley system'.	human eye (posterior, superior, lateral surface)	Intorsion	Depression	Abduction	
Inferior oblique muscle	Inferior branch of oculomotor nerve	Maxillary bone	human eye (posterior, inferior, lateral surface)	Extorsion	Elevation	Abduction	

5.2 Importance

Since only the fovea provides sharp distinct vision, the eye must move to follow a target. It must be precise and fast. This is seen in scenarios like reading, wherein the reader must shift gaze constantly, or following a small object like a golf ball, in which the extraocular muscles must lead the eye to follow the head movements. Although under voluntary control, most movement is done without thinking, such as those based on head or other body movement, or movement of objects in the area. Researchers still have some work in order to find the parallel nature of the environment-based (involuntary) and voluntary control.

5.3 Innervation

The nuclei or bodies of these nerves are found in the brain stem. The nuclei of the abducens and oculomotor nerves are connected. This is important in coordinating motion of the lateral rectus in one eye and the medial action on the other. In one eye, in two antagonistic muscles, like the lateral and medial recti, contraction of one leads to inhibition of the other. Muscles shows small degrees of activity even when resting, keeping the muscles taut. This ”tonic” activity is brought on by discharges of the motor nerve to the muscle.

5.4 Actions

Table 5.2:

Medial (towards nose)	**Lateral (towards temple)**
*Elevation, abduction:*Inferior oblique	*Elevation, adduction:*Superior rectus

Table 5.2: (continued)

Medial (towards nose)	**Lateral (towards temple)**
*Adduction:*Medial rectus	*Abduction:*Lateral rectus
*Depression, abduction:*Superior oblique	*Depression, adduction:*Inferior rectus

- These motions are only for eye examinations. Note that they are different from the intrinsic motor functions of each muscle. This is done in an exam to separate out the muscle being tested specifically.

In an eye examination, the inability of the patient to move the eye in the specified direction can indicate a problem with the associated muscle, and the nerve associated with that muscle.

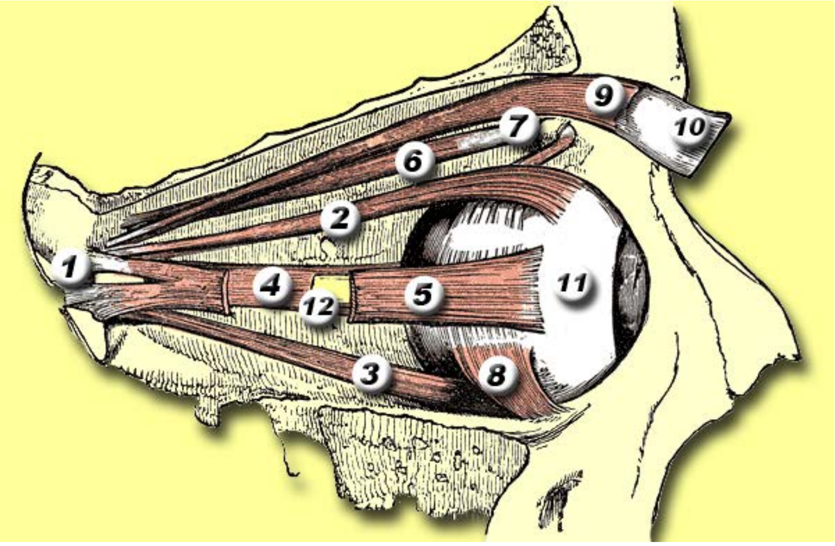
Coordination of Movement Between Both Eyes

Intermediate directions are controlled by simultaneous actions of multiple muscles. When one shifts the gaze horizontally, one eye will move laterally (toward the side) and the other will move medially (toward the midline). This may be neurally coordinated by the central nervous system, to make the eyes move together and almost involuntarily. This is a key factor in the study of squint, namely, the inability of the eyes to be directed to one point.

There are two main kinds of movement: conjugate movement (the eyes move in the same direction) and disjunctive (opposite directions). The former is typical when shifting gaze right or left, the latter is convergence of the two eyes on a near object. Disjunction can be performed voluntarily, but is usually triggered by the nearness of the target object. A ”see-saw” movement, namely, one eye looking up and the other down, is possible, but not voluntarily; this effect is brought on by putting a prism in front of one eye, so the relevant image is apparently displaced. To avoid double vision from non-corresponding points, the eye with the prism must move up or down, following the image passing through the prism. Likewise conjugate torsion (rolling) on the anteroposterior axis (from the front to the back) can occur naturally, such as when one tips one’s head to one shoulder; the torsion, in the opposite direction, keeps the image vertical.

The muscles show little inertia - a shutdown of one muscle is not due to checking of the antagonist, so the motion is not ballistic.

5.5 Paths



Five with paths from annulus of zinn

Five of the extraocular muscles have their origin in the back of the orbit in a fibrous ring called the annulus of Zinn.

Four of these then course forward through the orbit and insert onto the globe on its anterior half (i.e., in front of the eye's equator). These muscles are named after their straight paths, and are called the four rectus muscles, or four recti.

- *superior rectus* - inserts on the globe at 2
- *inferior rectus* - inserts on the globe at 3
- *medial rectus* - inserts on the globe at 4
- *lateral rectus* - inserts on the globe at 5

(Note that lateral and medial are relative to the subject, with lateral toward the side and medial toward the midline, thus the medial rectus is the muscle closest to the nose).

Two with more complex paths

The other two extraocular muscles follow more complicated paths.

- The *superior oblique* muscle originates at the back of the orbit (a little closer to the medial rectus, though medial to it, getting rounder as it courses forward to a rigid, cartilaginous pulley, called the trochlea, on the upper, nasal wall of the orbit. The muscle becomes tendinous about 10mm before it passes through the pulley, turning sharply across the orbit, and inserts on the lateral, posterior part of the globe. Thus, the superior oblique travels posteriorly for the last part of its path, going over the top of the eye. Due to its unique path, the superior oblique, when activated, pulls the eye downward and medially.
- The last muscle is the *inferior oblique*, which originates at the lower front of the nasal orbital wall, and passes under the LR to insert on the lateral, posterior part of the globe. Thus, the inferior oblique pulls the eye upward and laterally .

5.6 Rolling

The superior and inferior recti are not strictly vertical. The oblique pull of the obliques causes a rolling opposite each other. Although bearing mutual strict antagonism, the superior and inferior rectus team up with the inferior and superior oblique to move the eye up or down, respectively. The extent of rolling in the recti is less than the oblique, and opposite from it.

5.7 Mnemonics

A good mnemonic to remember which muscles are innervated by what nerve is to paraphrase it as a molecular equation: $LR_6SO_4R_3$. or $(LR_6SO_4)_3$ i.e. ”LR 6 SO 4 Whole 3.”

- Lateral Rectus - Cranial Nerve VI
- Superior Oblique - Cranial Nerve IV
- the Rest of the muscles - Cranial Nerve III.

Another way to remember which nerves innervate which muscles is to understand the meaning behind all of the Latin words.

- The *fourth cranial nerve*, the trochlear, is so named because the muscle it innervates, the superior oblique, runs through a little fascial pulley that changes its direction of pull (the trochlea of superior oblique). This pulley exists in the superiomedial corner of each orbit, and ”trochl-” is Latin for ”pulley.”
- The *sixth cranial nerve*, the *abducens*, is so named because it controls the lateral rectus, which abducts the eye (rotates it laterally) upon contraction.
- The *third cranial nerve*, the *oculomotor*, is so named because it is in charge of the movement (motor) of the eye (oculo-). It controls all of the other muscles.

5.8 See also

- Hering’s law of equal innervation
- Sherrington’s law of reciprocal innervation

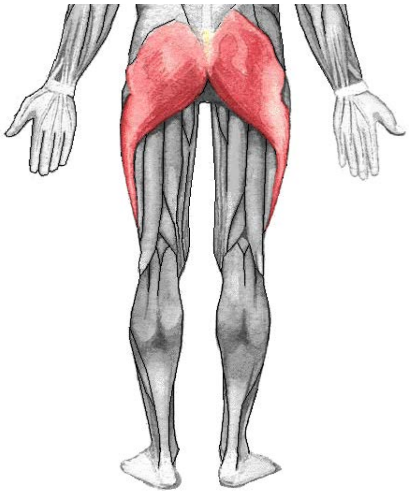
5.9 Additional images

5.10 External links

- *neuro/637* at eMedicine - ”Extraocular Muscles, Actions”
- University of Michigan *eye_13*

Chapter 6

Gluteal muscles



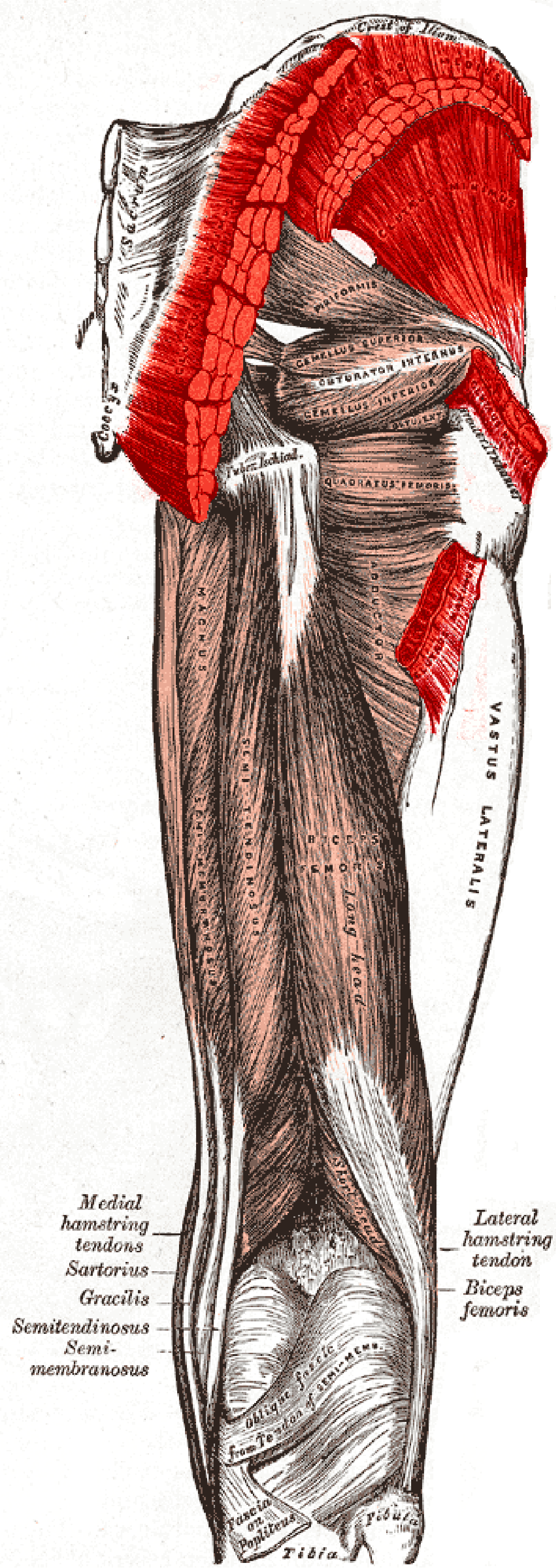
The **gluteal muscles** are the three muscles that make up the buttocks: the **gluteus maximus muscle**, **gluteus medius muscle** and **gluteus minimus muscle**.

6.1 The gluteal muscles

The gluteus maximus is the largest of the gluteal muscles and one of the Muscle#The .22strongest.22 human muscle in the human human anatomy. It inserts at the iliotibial band and the gluteal tuberosity of the femur. Its action is to extend and to laterally rotate the hip, and also to extend the trunk.

6.2 Problems associated with the gluteal muscles

Sitting for long periods can lead to the gluteal muscles



atrophying through constant pressure and disuse. This may be associated with (although not necessarily the cause of) lower back pain, difficulty with some movements that naturally require the gluteal muscles, such as rising from the seated position, and climbing stairs. SomeAvoid weasel words] attribute severe menstrual cycles including mood swings and irritability to gluteal muscle atrophy, however, there are a vast array of known contributors to dysmenorrhoea, and currently clinical evidence of such a causative association is lacking.

The bulk of the gluteal muscle mass contributes only partially to shape of the buttocks. The other major contributing factor is that of the panniculus adiposus of the buttocks, which is very well developed in this area, and gives the buttock its characteristic rounded shape. Although the gluteal muscle bulk and tone can be improved with massage and exercise, it is the disposition of the overlying panniculus adiposus which may be responsible for the ”sagging butt” phenomenon. Exercise in general (not only of the gluteal muscles but of the body in general) which can contribute to fat loss can lead to reduction of mass in subcutaneal fat storage locations on the body which includes the panniculus, so for leaner and more active individuals, the glutes will more predominantly contribute to the shape than someone less active with a fattier composition. The degree of body fat stored in various locations such as the panniculus is dictated by genetic and hormonal profiles.

6.3 Treatment

Studies have shown that exercise and massage are effective at reversing and protecting against atrophy of these muscles.

Poisoning by eating Lathyrus sativus Indian Pea or khesari dhal will lead to emaciation of buttock muscles (Neurolathyrism).

Exercise and stretching

Any exercise that works and/or stretches the buttocks is suitable, for example Lunge (exercise), climbing stairs, fencing, bicycling, owing (sport), squat (exercise)s, Glossary of ballet terms#Arabesque, aerobics, and various specific exercises for the bottom.

Powerlifting exercises which are known to significantly strengthen the gluteal muscles include the squat (exercise), deadlift, leg press, feet in squats (chin on chest & stick glutes out) and Good-morning (bend over with a bar on the shoulders with a light amount of weight).

6.4 See also

Gluteal crease

6.5 References

Image Sources

- McMinn, RMH (Ed) (1994) Last’s Anatomy: Regional and applied (9th Ed). London: Churchill Livingstone. ISBN 0-443-04662-X

6.6 External links

- 8b. The Muscles and Fasciæ of the Thigh Bartleby.com, Henry Gray, Anatomy of the Human Body, 1918.

Chapter 7

Facial muscles

The **facial muscles** are a group of striated muscles innervated by the facial nerve that, among other things, control facial expression. These muscles are also called mimetic muscles.

7.1 Structure

The facial muscles are subcutaneous (just under the skin) muscles that control facial expression. They generally originate on bone, and insert on the skin of the face.

7.2 Innervation

The facial muscles are innervated by facial nerve (cranial nerve VII). In contrast, the nearby masticatory muscles are innervated by the mandibular nerve, a branch of the trigeminal nerve (V).

7.3 Development

The facial muscles are derived from the second branchial/pharyngeal arch.

7.4 List of muscles

The facial muscles include:

- Occipitofrontalis
- Temporoparietalis muscle
- Procerus
- Nasalis muscle
- Depressor septi nasi
- Orbicularis oculi
- Corrugator supercilii
- Depressor supercilii
- Auricular muscles (anterior, superior, posterior)
- Orbicularis oris

- Depressor anguli oris
- Risorius
- Zygomaticus major
- Zygomaticus minor
- Levator labii superioris
- Levator labii superioris alaeque nasi
- Depressor labii inferioris
- Levator anguli oris
- Buccinator
- Mentalis

The platysma is innervated by the facial nerve. Although it is mostly in the neck, due to its common innervation it can sometimes also be considered a muscle of facial expression.

The stylohyoid muscle, stapedius and posterior belly of the digastric muscle are also innervated by the facial nerve, but are not considered muscles of facial expression.

7.5 See also

- Masticatory muscles
- Facial nerve
- Facial Action Coding System
- Modiolus

7.6 References

Image Sources

(1) {{cite book |author=Kyung Won, PhD. Chung |title=Gross Anatomy (Board Review) |publisher=Lippincott Williams & Wilkins |location=Hagerstown, MD |year=2005 |isbn=0-7817-5309-0 |oclc= |doi= |page=364}}

|

7.7 External links

- ARTNATOMY: Anatomical Basis of Facial Expression Learning Tool
- *lesson1* at *The Anatomy Lesson* by Wesley Norman (Georgetown University)

SFacial_muscles

Template documentation

Chapter 8

Infrahyoid muscles

The **infrahyoid muscles** are a group of four pairs of muscles in the anterior part of the neck. (The term **infrahyoid** refers to the region below (inferior) to the hyoid bone in the neck.)

Collectively, they are referred to as the *strap muscles*, because the muscles are long and flat much like a strap.

8.1 Individual muscles

Namely, the muscles are:

Table 8.1:

Muscle	**Origin**	**Insertion**	**Innervation**
sternothyroid muscle	Human sternum	thyroid cartilage	ansa cervicalis
sternohyoid muscle	Human sternum	hyoid bone	ansa cervicalis
thyrohyoid muscle	thyroid cartilage	hyoid bone	Cervical spinal nerve 1 (via hypoglossal nerve
omohyoid muscle	intermediate tendon	hyoid bone	superior root of ansa cervicalis
omohyoid muscle	superior border of scapula	intermediate tendon	ansa cervicalis

8.2 Innervation

All of the infrahyoid muscles are innervated by ansa cervicalis from the cervical plexus(C1-3) EXCEPT for the thyrohyoid muscle, which is innervated by only C1.

The stylopharyngeus muscle is considered by many to be one of the strap muscles, but it is innervated by CN IX rather than the ansa cervicalis.

8.3 Action

These four muscles, also known as the ”strap” muscles, function to depress the hyoid bone and larynx during swallowing and speaking (except for Thyrohyoid).

8.4 See also

- Muscular triangle
- Suprahyoid muscles

8.5 References

Image Sources

(1) {{cite book |author=Ellis, Harold; Susan Standring; Gray, Henry David |title=Gray’s anatomy: the anatomical basis of clinical practice |publisher=Elsevier Churchill Livingstone |location=St. Louis, Mo |year=2005 |pages=538–539 |isbn=0-443-07168-3 |oclc= |doi= |accessdate=2 June 2010}}

SInfrahyoid_muscles

Template documentation

Chapter 9

Scalene muscles

The **scalene muscles** (from Greek language , or *skalenos*, meaning uneven) are a group of three pairs of muscles in the lateral neck, namely the scalenus anterior, scalenus medius, and scalenus posterior.

They are innervated by the spinal nerves C4-C6.

9.1 Origin and insertion

They originate from the transverse processes from the cervical vertebrae of C2 to C7 and insert onto the first and second ribs. Thus they are called the **lateral vertebral muscles**.

9.2 Function

The action of the anterior and middle scalene muscles is to elevate the first rib and laterally flex the neck to the same side; the action of the posterior scalene is to elevate the second rib and tilt the neck to the same side.

They also act as accessory muscles of inspiration, along with the sternocleidomastoids.

9.3 Relations

The scalene muscles have an important relationship to other structures in the neck. The brachial plexus and subclavian artery pass between the anterior and middle scalenes. The subclavian vein and phrenic nerve pass anteriorly to the anterior scalene as it crosses over the first rib.

The passing of the brachial plexus and the subclavian artery through the space of the anterior and middle scalene muscles constitute the scalene hiatus (the term ”scalene fissure” is also used). The region in which this lies is referred to as the scaleotracheal fossa. It is bound by the clavicle inferior anteriorly, the trachea medially, posteriorly by the trapezius, and anteriorly by the platysma muscle.

9.4 See also

- Muscles
- List of muscles of the human body

- Accessory muscles of respiration

9.5 Additional images

The origin of the scalenes is 1st and 2nd ribs The insertion is the transverse processes of c2-c7.

Chapter 10

Intercostal muscle

Intercostal muscles are several groups of muscles that run between the ribs, and help form and move the chest wall. The intercostal muscles are mainly involved in the mechanical aspect of breathing. These muscles help expand and shrink the size of the chest cavity when you breathe.

There are three principal layers;

- the external intercostal muscles, which aid in quiet and forced inhalation. They originate on ribs 1-11 and have their insertion on ribs 2-12. The external intercostals are responsible for the elevation of the ribs, and expanding the transverse dimensions of the thoracic cavity.
- the internal intercostal muscles, which aid in forced expiration (quiet expiration is a passive process). They originate on ribs 2-12 and have their insertions on ribs 1-11. The internal intercostals are responsible for the depression of the ribs decreasing the transverse dimensions of the thoracic cavity.
- the innermost intercostal muscle, the deep layers of the internal intercostal muscles which are separated from them by the neurovascular bundle. This in turn is composed of:
  - transversus thoracis muscle
  - intercostal space
  - subcostalis muscle

Both the external and internal muscles are innervated by the intercostal nerves (the ventral rami of thoracic spinal nerves), and are provided by the intercostal arteries and intercostal veins. Their fibers run in opposite directions.

The scaleni, which also move the chest wall and have a function in inhalation, are also intercostal muscles, just not one of the three principal layers.

10.1 See also

- Thoracic diaphragm, another muscle heavily involved in respiration

10.2 External links

- *-294977459* at GPnotebook
- SUNY Downstate Medical Center *18:03-03*
- UCC

SIntercostal_muscle

Template documentation

Chapter 11

Rhomboid muscles

The **rhomboid muscles**, often simply called the **rhomboids**, are rhombus-shaped muscles associated with the scapula and are chiefly responsible for its retraction. There are two rhomboid muscles:

- Rhomboid major muscle
- Rhomboid minor muscle

SRhomboid_muscles

Template documentation

Chapter 12

Fabulous Muscles

Fabulous Muscles is the third album by Xiu Xiu, released on February 17, 2004 on 5 Rue Christine. The album marked a change in the band's sound, as the album was considered to be more accessible than Xiu Xiu's previous two albums. *Fabulous Muscles* has received mostly positive reviews.

12.1 Overview

Fabulous Muscles was Xiu Xiu's third album in two years. The album was recorded in Oakland, California and Seattle and was produced by band member Cory McCulloch. The album's cover features frontman Jamie Stewart nuzzling a kitten.

Several reviewers found *Fabulous Muscles* to have a more accessible sound than Xiu Xiu's previous albums. On recording the album, Stewart said:

Table 12.1:

"	I think on *Fabulous Muscles* we really tried to write a pop record just because... We were on a lark and wanted to see how it would turn out.	"

The track "Brian the Vampire" is based on a child Stewart encountered during Stewart's time as a preschool teacher in California. "Mike" is a tribute to Stewart's late father Michael Stewart (musician), who had committed suicide in 2002, while "Support Our Troops OH! (Black Angels OH!)" is about Stewart's view on soldiers serving in the Iraq war.

12.2 Reception

Fabulous Muscles has received mostly positive reviews. On the review aggregate site Metacritic, the album has a score of 80 out of 100, indicating "Generally favorable reviews." Critics were generally receptive to the album's more accessible sound.

Heather Phares of Allmusic wrote "*Fabulous Muscles* might be the best expression of Xiu Xiu's unrepentantly original music; even if the world that the band creates isn't necessarily one you'd want to visit all the time, it remains fascinating." Pitchfork Media's Matt LeMay also praised the album, writing "Though there are many notable high points to *Fabulous Muscles*, its overwhelming consistency is what cements its place as Xiu Xiu's finest. The album does not contain a single hiccup or yawn– no extraneous noise, no potentially offputting histrionics, no throwaways and no dull moments." The album also received a "Best New Music" designation in the review.

Robert Christgau gave the album a C grade, writing "The musical parsimony, cultural insularity, moral certitude, and histrionic affectations of these lo-fi artier-than-thous promise indie ideologues whole lifetimes of egoistic irrelevance." Stylus Magazine's Akiva Gottlieb also gave the album a C grade, writing "Obviously, Stewart has a penchant for self-examination—some of it brilliant and incisive—but his work is also obnoxiously self-indulgent."

Fabulous Muscles has appeared on a few end of year lists. The Morning News (online magazine) named it the 7th best album of 2004. Pitchfork Media ranked *Fabulous Muscles* #50 on their list of the top 50 albums of 2004. In addition, the same website ranked the song "I Luv the Valley OH!" #176 on their list of the Top 500 Tracks of the 2000s, with reviewer Brian Howe writing "A great Xiu Xiu song is like someone actually hurting himself, right in front of you. This ["I Luv the Valley OH!"] isn't their most violent effort, but it's their most scouring; a place where mortar-round drums pound down on rolling bass and chiming guitars, unsubtly conveying the painful insight that some dreams have to be razed, not realized."

12.3 Track listing

Table 12.2:

No.	Title	Length
1.	"Crank Heart"	3:19
2.	"I Luv the Valley OH!"	2:59
3.	"Bunny Gamer (b)"	2:40
4.	"Little Panda McElroy (b)"	4:25
5.	"Support Our Troops OH! (Black Angels OH!)"	4:46
6.	"Fabulous Muscles "	4:10
7.	"Brian the Vampire"	2:38
8.	"Nieces Pieces "	3:33
9.	"Clowne Towne"	3:50
10.	"Mike"	5:13

12.4 Personnel

The following people contributed to *Fabulous Muscles*:

Xiu Xiu

- Lauren Andrews - Percussion, Synthesizer
- Jherek Bischoff - Bass, Bass (Upright), Drums (Bass), String Arrangements, Synthesizer, Trombone, Violin

- Cory McCulloch - Guitar, Harmonium, Mandolin, Producer, Synthesizer Bass
- Sam Mickens - Guitar
- Jamie Stewart - Bass, Beats, Guitar, Synthesizer, Vocals

Additional personnel

- John Golden - Mastering
- Lorem Ipsum - Photography
- Caralee McElroy - Photography
- Gabriel Mindel - Electronics, Guitar, Synthesizer
- Sprout Guy - Viola, Violin
- Joe Stewart - Design
- Peter Swanson - Drum Machine, Electronics, Synthesizer

12.5 External links

- Amazon.com listing

Chapter 13

Papillary muscle

In anatomy, the **papillary muscles** are muscles located in the ventricles of the heart. They attach to the cusps of the atrioventricular valves (a.k.a. the mitral valve and tricuspid valve valves) via the chordae tendinae and contract to prevent inversion or prolapse#Heart valve prolapse of these valves.

13.1 Action

There are five total papillary muscles in the heart, three in the right ventricle and two in the left. The anterior, posterior, and septal papillary muscles of the right ventricle each attach via chordae tendineae to the tricuspid valve. The anterior and posterior papillary muscles of the left ventricle attach via chordae tendineae to the mitral valve.

The papillary muscles of both the right and the left ventricles begin to contract shortly before ventricular systole and maintain tension throughout. This prevents regurgitation–backward flow of ventricular blood into the atrial cavities–by bracing the atrioventricular valves against prolapse–being forced back into the atria by the high pressure in the ventricles.

13.2 Rupture

Papillary muscle rupture, as can be caused by a heart infarct, and dysfunction, as can be caused by ischemia, can both lead to the complication of mitral valve prolapse.

13.3 Additional images

13.4 See also

- Trabeculae carneae

13.5 External links

- *papillary+muscle* at eMedicine Dictionary
- SUNY Downstate Medical Center *20:19-0106* - ”Heart: The Right Atrioventricular (Tricupsid) Valve”

(anterior, posterior, septal papillary muscles)

- SUNY Downstate Medical Center *20:26-0105* - "Heart: The Left Atrioventricular (Mitral) Valve" (anterior, posterior papillary muscles)
- *-1368719301* at GPnotebook
- University of Wisconsin-La Crosse *Human heart model (left internal anatomy)*
- University of Michigan *ht_rt_vent* - "Right atrioventricular bundle branch, anterior view"
- Definition of Papillary muscle
- MedicineNet Search Results
- Visit the educational website www.themitralvalve.org

SPapillary_muscle

Template documentation

Chapter 14

Pharyngeal muscles

The **pharyngeal muscles** are a group of muscles that act upon the pharynx.

They include:

- Inferior constrictor muscle
- Middle constrictor muscle
- Superior constrictor muscle
- Stylopharyngeus muscle
- Salpingopharyngeus muscle
- Palatopharyngeus muscle

SPharyngeal_muscles

Template documentation

Chapter 15

Muscles of respiration

The various **muscles of respiration** aid in both inhalation and exhalation, which require changes in the pressure within the thoracic cavity. The respiratory muscles work to achieve this by changing the dimensions of the thoracic cavity.

The principal muscles are the Thoracic diaphragm, the External intercostal muscles and the interchondral part of the internal intercostal muscles. Both the external intercostal muscles and the intercondral elevate the ribs, thus increasing the width of the thoracic cavity, while the diaphragm contracts to increase the vertical dimensions of the thoracic cavity, and also aids in the elevation of the lower ribs.

Accessory muscles are typically only used when the body needs to process energy quickly (e.g. during heavy exercise, during the stress response, or during an asthma attack). The accessory muscles of inspiration can also become engaged in everyday breathing when a breathing pattern disorder exists.

15.1 The diaphragm

The diaphragm is crucial for breathing and Respiration (physiology). It's responsible for ˜75% of the air that enters the lungs during quiet breathing. During inhalation, the diaphragm contracts, thus enlarging the thoracic cavity (the intercostal muscle also participate in this enlargement). This reduces intra-thoracic pressure: in other words, enlarging the cavity creates suction that draws air into the lungs. When the diaphragm relaxes, air is exhaled by elastic recoil of the lung and the tissues lining the thoracic cavity in conjunction with the abdominal muscles which act as an Antagonist (muscle) paired with the diaphragm's contraction.

It is not responsible for all the breathing related to voice, a common misconception espoused by many teachers but few great singers. One has more control over the abdominals and Intercostal muscle than the actual diaphragm, which has relatively few proprioceptive nerve endings. By training proper posture and balance in the rest of the body, the diaphragm naturally strengthens and works in concert with surrounding structures rather than in isolation.

The diaphragm is also involved in non-respiratory functions, helping to expel vomit, feces, and urine from the body by increasing intra-abdominal pressure, and preventing acid reflux by exerting pressure on the esophagus as it passes through the esophageal hiatus.

15.2 The intercostal muscles

Along with the thoracic diaphragm, the intercostal muscles are one of the most important groups of respiratory muscles. The external intercostals are responsible for ˜25% of the air that enters the lungs during quiet breathing. These muscles are attached between each rib and are important in manipulating the width of the thoracic cage. There are three layers of intercostal muscles:

- The *external intercostal* have fibres that go forward and downward (obliquely downward and forward from rib to rib). These fibres are called the *antero-inferior*, and are sometimes referred to as the *front pocket muscle* since the fibres mimic the direction a hand would enter a front pocket. The external intercostals assist in deep inspiration by increasing the anterioposterior diameter of the chest.
- The *internal intercostal* also have fibres, which go backward and downward (obliquely downward and posteriorly from rib to rib). These are called the *postero-superior*, or the *back pocket muscles.* The internal intercostals assist in expiration by pulling the ribcage down.
- The last layer is the *innermost intercostals* and consists of three separate parts; the subcostal (posteriorly), the innermost intercostal (laterally, which often causes confusion with the innermost intercostal referring to all twenty groups) and the transversus thoracis (anteriorly).

The antero-inferior fibres have the effect of lifting up the ribs during contraction. Anteriorly, the external intercostal muscles do not directly attach to the sternum, but are replaced by the anterior intercostal membrane.

The innermost intercostal muscles are also ”back pocket” muscles. The internal and innermost intercostals have the opposite effect of the external intercostals and aid in forced expiration. The internal intercostal is replaced by the posterior intercostal membrane posteriorly.

15.3 Accessory muscles of inspiration

There is some controversy as to which muscles may be considered accessory muscles of inspiration (Kendalll, McCreary, Provance, Rodgers, Romani, 2005). The sternocleidomastoid (elevated sternum) and the scalene muscles (anterior, middle and posterior scalene) are typically considered accessory muscles of breathing ., however the following muscles have also been observed contributing to the breathing: serratus anterior, pectoralis major & minor, upper trapezius, latissimus dorsi, erector spinae (thoracic), iliocostalis lumborum, quadratus lumborum, serratus posterior superior and inferior, levatores costarum, transversus thoracis, subclavius (Kendall et al., 2005).

Scalene muscle activation coincides with the diaphragm even at rest in most humans, suggesting it could be considered a primary muscle of respiration

If a breathing pattern disorder exists, the accessory muscles of inspiration may become overused.

15.4 Muscles of expiration

During quiet breathing, there is little or no muscle contraction/relaxation involved in expiration. This process is simply driven by the elastic recoil of the lungs in healthy individuals. In certain conditions the elasticity of the lung can be lost, such as in emphysema. Forced (active)or expiration occurs in such individuals as well as occurring during exercise. The abdominal muscles and the internal and innermost intercostal muscles help expel air.

15.5 Further reading

- Kendall, F., McCreary, E., Provance, P., Rodgers, M., Romai, W. (2005). **Muscles testing and function with posture and pain (5th ed.)**. PA, USA: Lippincott Williams & Wilkins.

Chapter 16

Sternohyoid muscle

The **sternohyoid muscle** is a thin, narrow muscle attaching the hyoid bone to the Human sternum, one of the paired strap muscles of the infrahyoid muscles serving to depress the hyoid bone. It is innervated by the ansa cervicalis.

The muscle arises from the posterior border of the medial end of the clavicle, the posterior sternoclavicular ligament, and the upper and posterior part of the manubrium sterni.

Passing upward and medially, it is inserted by short tendinous fibers into the lower border of the body of the hyoid bone.

16.1 Variations

Doubling; accessory slips (Cleidohyoideus); absence.

It sometimes presents, immediately above its origin, a transverse tendinous inscription.

16.2 Additional images

16.3 External links

- Loyola University Chicago *steh*
- SUNY Downstate Medical Center *25:10-0103* - "Nerves and Vessels of the Carotid triangle"
- *sternohyoid+muscle* at eMedicine Dictionary
- PTCentral

This article was originally based on an entry from a public domain edition of Gray's Anatomy. As such, some of the information contained within it may be outdated.

SSternohyoid_muscle

Template documentation

Chapter 17

Recti muscles

Recti muscles can refer to:

- Superior rectus muscle
- Inferior rectus muscle
- Medial rectus muscle
- Lateral rectus muscle

Chapter 18

Prevertebral muscles

The **prevertebral muscles** are the muscles located between the prevertebral fascia (older definition) and the vertebral column, i.e., the longus capitis and longus colli muscles.

It also includes the recti capitis anterior and lateralis.

18.1 See also

- Prevertebral space

18.2 References

Image Sources

(1) kobiljak.msu

(2) `http://www.dartmouth.edu/~humananatomy/part_8/chapter_50.html`

SPrevertebral_muscles

Template documentation

Chapter 19

Obturator muscles

Obturator muscles can refer to:

- Obturator externus muscle
- Obturator internus muscle

Chapter 20

Muscles of larynx

The muscles of the larynx are extrinsic, passing between the larynx and parts around; and intrinsic, confined entirely to the larynx.

The intrinsic muscles are divided into respiratory and the phonatory muscles (the muscles of phonation). The respiratory muscles move the vocal chords apart and serve breathing. The phonatory muscles move the vocal cords together and serve the production of voice.

The main respiratory muscles are the posterior cricoarytenoid muscles. The phonatory muscles are divided into adductors (lateral cricoarytenoid muscles, arytenoid muscles) and tensors (cricothyroid muscles, thyroarytenoid muscles).

20.1 External links

- *lesson11* at *The Anatomy Lesson* by Wesley Norman (Georgetown University)

This article was originally based on an entry from a public domain edition of Gray's Anatomy*. As such, some of the information contained within it may be outdated.*

SMuscles_of_larynx

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Template documentation

Chapter 21

Transversospinales muscles

The **transversospinal muscles** are a group of muscles of the human back. Their combined action is rotation and extension of the vertebral column. They include:

- semispinalis, spanning 4-6 vertebral segments
  - semispinalis dorsi
  - semispinalis cervicis
  - semispinalis capitis
- multifidus muscle, spanning 2-4 vertebral segments
- rotatores muscle, spanning 1-2 vertebral segments
  - rotatores cervicis
  - rotatores thoracis
  - rotatores lumborum

21.1 External links

- *transversospinales+%28muscles%29* at eMedicine Dictionary

STransversospinales_muscles

Template documentation